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MACHINERY

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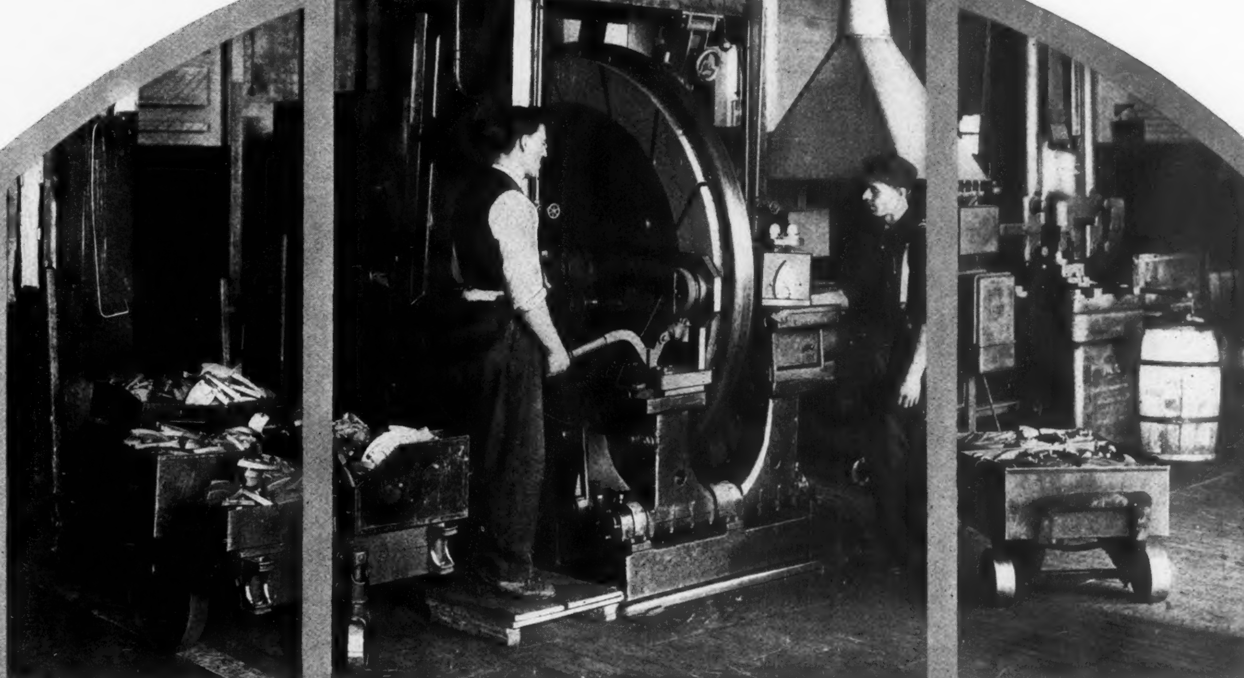


Some Electrical Manufacturing Operations

by Chester L. Lucas

THOSE who have seen a General Electric Co.'s fan, must have noticed the ingeniously formed wire fan guard with which it is equipped. A fan motor with the guard in place is shown in Fig. 1, and Fig. 2 shows the guard alone. It is the purpose of this article to describe the making of this guard and also to show a few of the interesting operations incident to the making of other electrical apparatus.

A study of the guard in Fig. 2 will show that it is made up of a central monogram cup, eight arms, a front rim and a rear rim. As two arms are made from one piece of wire, the entire guard is made from the monogram and six lengths of wire. In the case of smaller sizes of guards, where there are but six arms, only five pieces of wire are necessary. The group of halftone illustrations Figs. 3 to 9 show the different steps the arms and rims pass through from the first operation to the assembling of the finished piece.

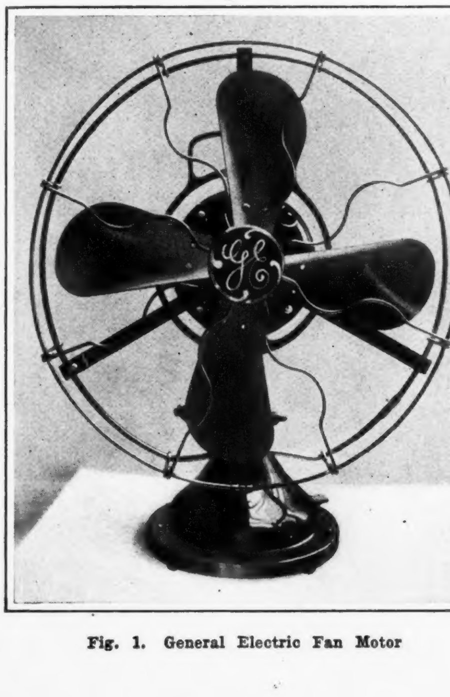


Fig. 1. General Electric Fan Motor

The brass wire is first cut to lengths which are long enough to make two complete arms, including all the bends. Then, as shown in Fig. 3, the wire is centrally located in the bending fixture and held from creeping during the bending operations by the clamp at the center. A gage at the right assists in locating the wire. At each end of the fixture are two fulcrum pins around which the bends are made with the aid of a hand key having a central hole to engage the fulcrum pin and a projecting stud that is spaced far enough from the hole to reach over the wire and control the bending when the key is turned. The lower of the fulcrum pins may be slid below the surface of the fixture so as to be out of the way while the upper bends are being made. One turn of the key completes each upper bend and a half turn forms each end bend. This fixture swivels on its base and the

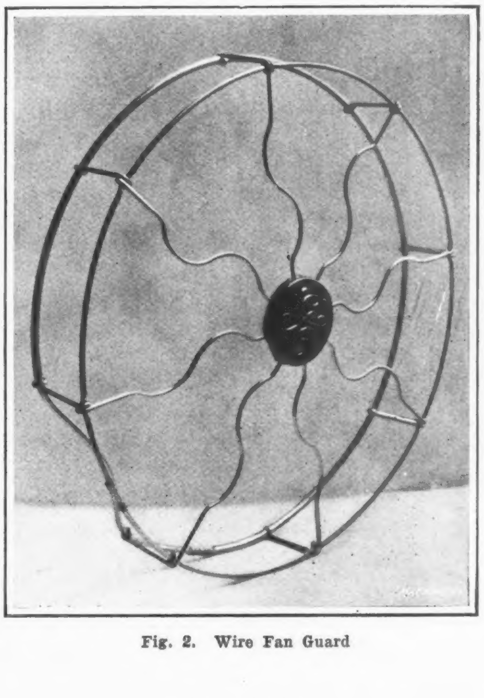


Fig. 2. Wire Fan Guard

Fig. 3. Bending Fixture for Preliminary bending of Wire Fan Guard

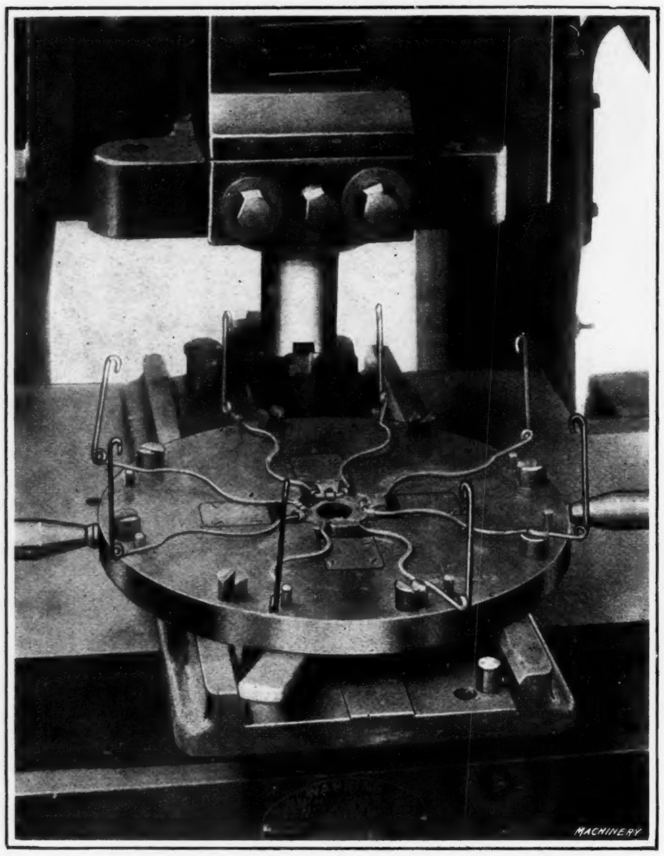


Fig. 4. Punch and Die for assembling Wire Arms and Center Plate

bending is rapidly handled at the rate of one hundred wires per hour.

The second and third steps are bending operations and are performed in the dies illustrated in Figs. 5 and 6. In Fig. 5 the die and punch are built up from rolls and formed sections having central grooves to receive the wire and form it without marring. Gages on the ends of the die and on the front side of punch and die support the ends of the wire and insure that the bending is done at right angles to the end sections.

The die shown in Fig. 6 performs the final operation on the double-arm wire, and makes the angular bend that leaves it ready for assembling. The wire is located from the bends previously made. The operating slide of the die has a recess that matches the stationary form in front of it, and as the slide advances, the bend is made. The slide is advanced by the tapered punch that descends behind it and moves it forward. Spring pressure brings it back for the next stroke.

The assembling of the guard is started by the die shown in Fig. 4, whose function it is to close the lugs in the center plate over the four double arm wires. To facilitate placing the work in position, the die is mounted on a slide on the bed plate. The center plate is first located and then the four wires are placed in position, the outer ends of the arms being supported by guides around the edge of the work-holder. One stroke of the punch turns the twelve lugs over and closes them on the arm wires. The lever at the front ejects the work.

The rim wires are cut off and formed by rolling, and the ends of each rim are joined by a short piece of brass tube crimped in place. Before the ends of the front rim wire can be joined, the wire must be run through the arm loops by hand. After joining the ends of the front rim wire, the loops are pressed down onto it by the tools shown in Fig. 7. This operation accomplishes a twofold purpose—improving the general appearance of the guard and locking the arms into their correct positions so that they cannot shift. This set of tools is the most complicated of those required for making the guard. After the guard has been placed in the die, with the eight arms properly located, handle *A* is thrown hard to the left. This moves the ring to which it is attached, and the movement causes the eight sliding blocks *B* to travel outward, reaching

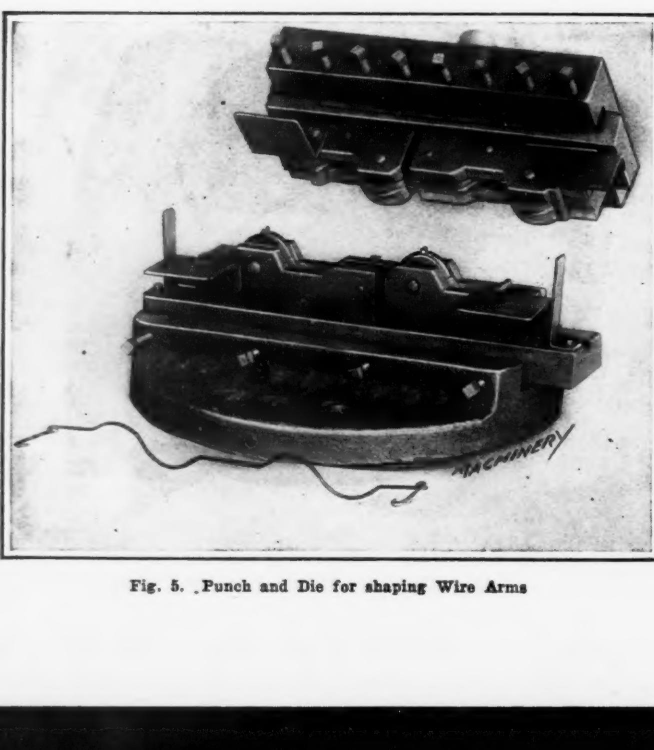


Fig. 5. Punch and Die for shaping Wire Arms

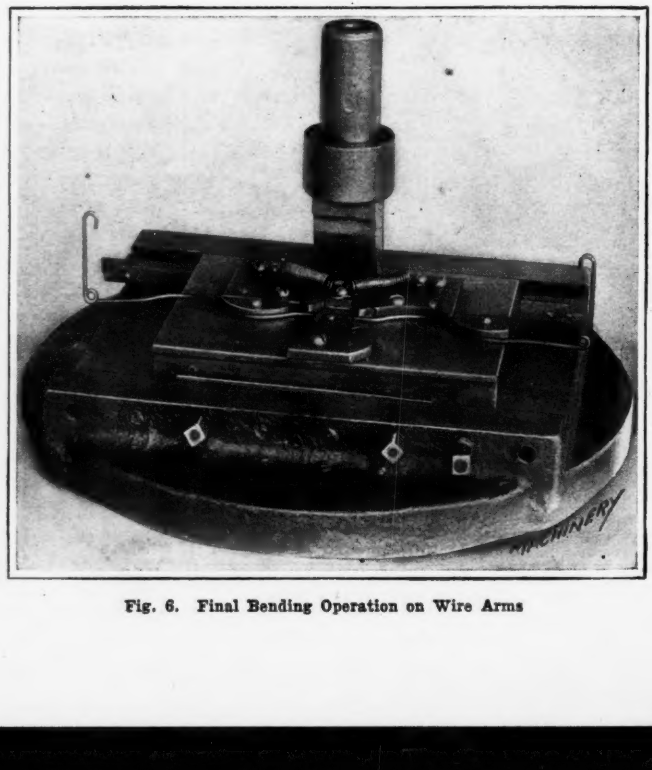


Fig. 6. Final Bending Operation on Wire Arms

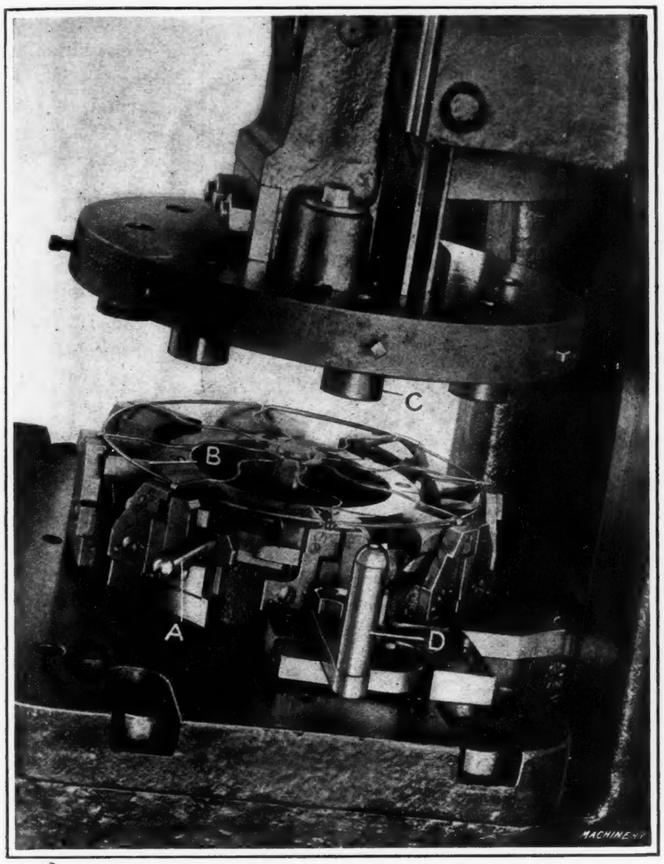


Fig. 7. Inclined Press for assembling Front Rim Wire and Arms

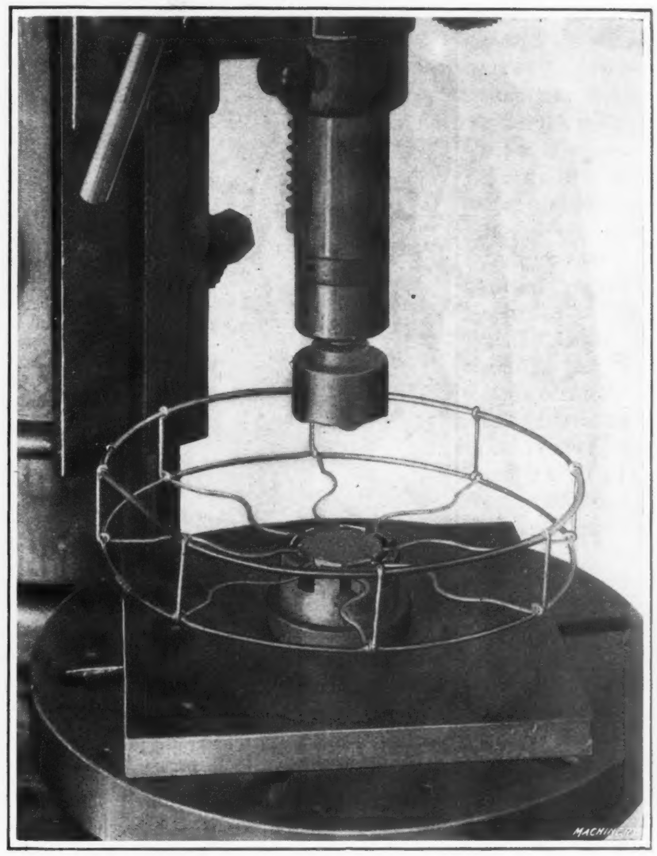


Fig. 8. Tool for applying Monogram to Center of Guard

under the arm loops. In this position, the press is tripped and the eight studs *C* on the punch flatten down the loops and depress them into the rim wire. To facilitate loading, the die is pivoted at the left-hand side and may be swung out from under the punches. Latch *D* holds it in the operating position.

The rear rim wire, after having been joined by a short piece of tubing, is dropped into the end bends of the arms and the loops are closed over the rim wire in the die shown in Fig. 9. The die has eight angular posts to back up the arm wires and in each of these posts is a steel insert grooved to receive the wire. In the central casting of the die there are eight plungers, operated by the central punch. The working ends of these plungers are formed to fit the ends of the arm wires and curl them around the rear rim wire when the punch is struck by the "pusher" on the ram. Spring fingers hold the guard in place for this operation and the plungers are withdrawn by springs.

The depression in the bottom of the inner or rear rim wire is made to clear the base of the fan motor. This is a simple operation and is performed with a pair of bending dies in a horn press. The final operation, that of applying the monogram to the center of the fan guard, is accomplished in a drilling machine as shown in Fig. 8. Eight slots in the monogram rim permit it to be placed over the wires from the front, and after dropping in the thin backing plate the edges of the monogram are spun over by a tool in the drilling machine. After lacquering, the guard is mounted on the motor as in Fig. 1.

Semi-automatic Spinning Lathe

The semi-automatic spinning machine used for spinning the lighting arrester cones is of more than ordinary interest. This machine is a Pryibil spinning lathe of the gap pattern, and is tooled as shown in Figs. 11 and 14. The lighting arrester cones are made of aluminum 0.037 inch thick and are shaped about as shown in Fig. 14, being approximately 10 inches in

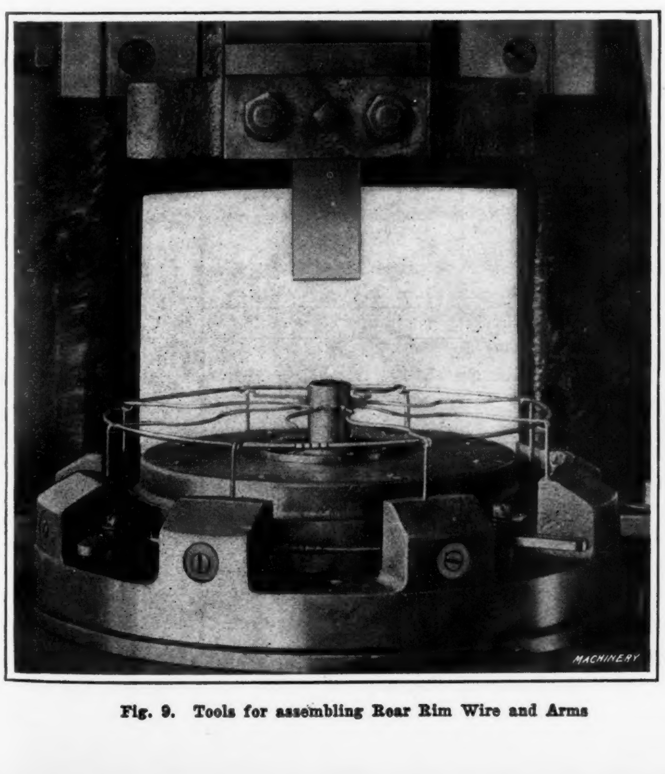


Fig. 9. Tools for assembling Rear Rim Wire and Arms

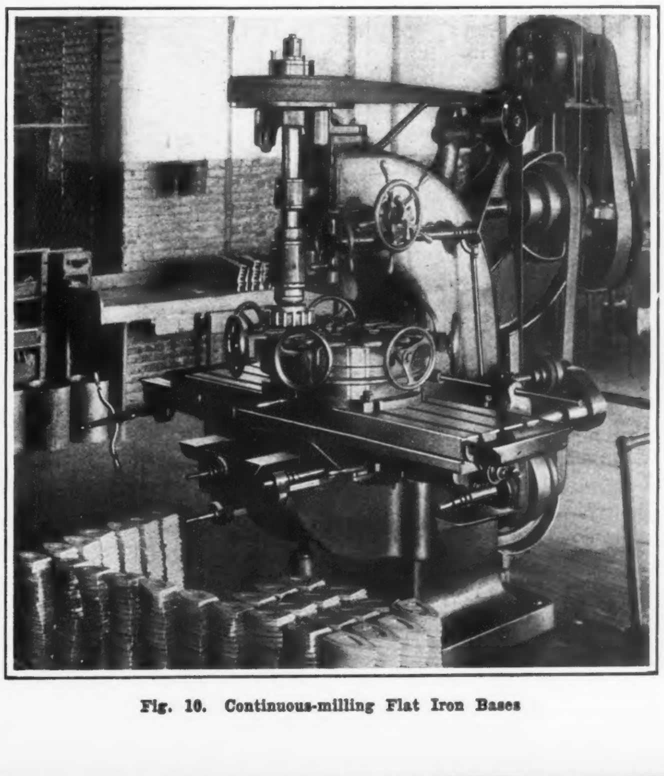


Fig. 10. Continuous-milling Flat Iron Bases

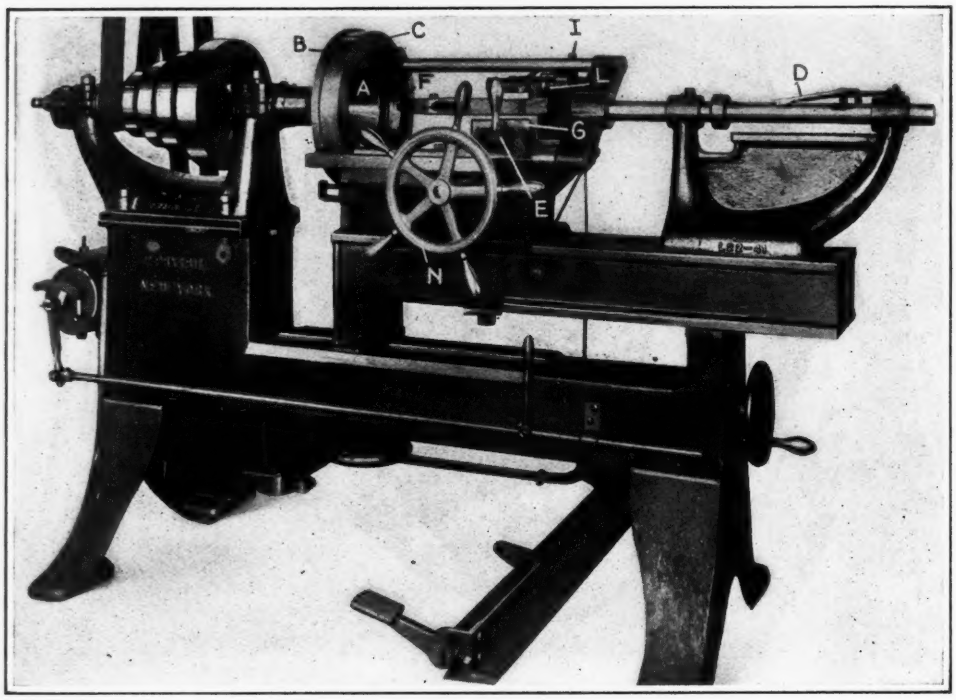


Fig. 11. Semi-automatic Metal Spinning Machine

diameter and 7 inches from base to peak. The reflectors are spun rather than drawn because the spinning operation subjects the metal to a tension that is highly desirable for the use to which they are put. There is a female spinning form on the headstock of the lathe, and a blank-holder operated from the tailstock holds the work while it is spun inward to fill the form.

Fig. 14 shows a diagrammatical view of the mechanism by which the spinning is done, and from this it will be seen that the spinning form shown at A is located directly on the spindle of the machine, which travels at approximately 1000 R. P. M. The blank is placed in the blank-holder B, and pressed against the form by means of the tail-

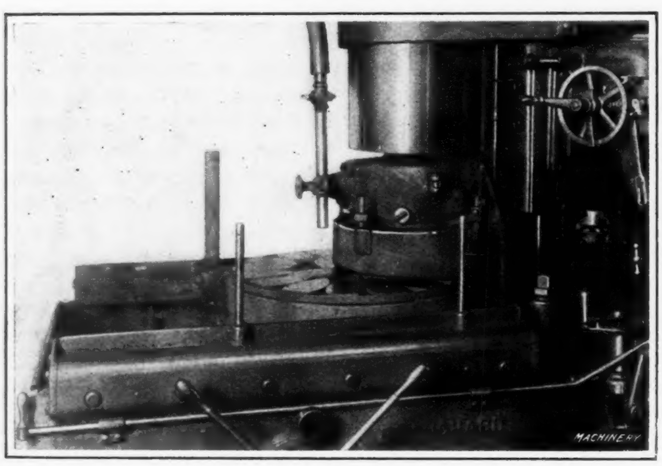


Fig. 12. Surface Grinding Flat Iron Bases

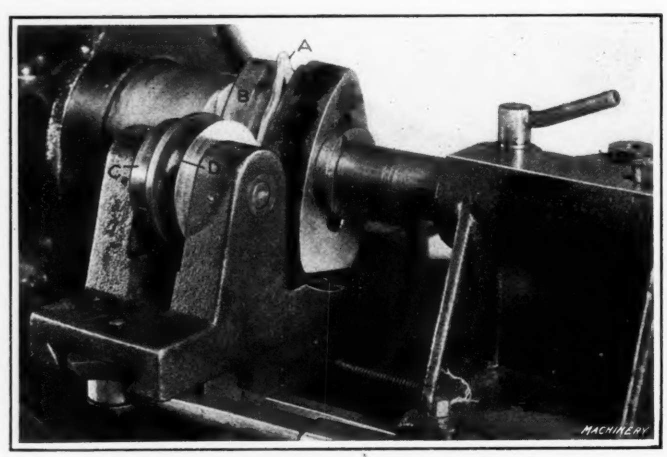


Fig. 13. Trimming Flanges from Flat Iron Clamp Covers

block C that is held by two bars that run back to the tailstock. The friction between the tail-block and the form is overcome by means of a ball bearing located on the tailstock holder. A clamping lever D on the tailstock locks the work.

The spinning mechanism itself is controlled by the movement of arm E that carries the spinning tool F located on a sliding carriage G. By means of an electric motor at the pivot of this arm indicated at H in Fig. 14, a worm-wheel I is turned continuously. On the same shaft with this worm-wheel is a pinion J that meshes with a rack which is part of a bar K attached to carriage G on which the spinning tool is located. The pinion and bar K may be caused to operate at will by clutch L and the rack consequently advances carriage G and hence the spinning tool F. A spring M is provided which tends to pull carriage G back toward the pivot of arm E. By means of the foot-treadle shown in Fig. 11, the operator can engage the clutch and cause carriage G to be pushed inward by means of the rack and pinion motion previously explained, and when the foot pressure is released, the clutch is thrown out and the spring pulls the carriage back ready for another stroke. Arm E, with the carriage and tool, is caused to swing toward the spinning chuck when the tool is advanced by wheel N that reciprocates the regulation carriage. Upon the carriage is a plate with a slot O inclined at an angle of approximately 45 degrees. Pin P which projects beneath arm E engages slot O. When the carriage is moved toward the chuck, the pressure of the side of the inclined slot upon stud P tends to swing the arm inward on pivot H toward the chuck. Thus, with the action of the rack and pinion pulling carriage G and the spinning tool F *toward* the operator, there is combined the motion of the carriage

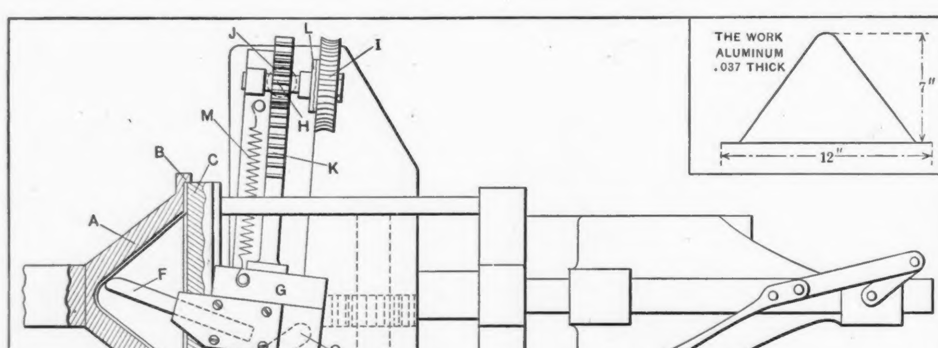


Fig. 14. Diagram illustrating Operation of Metal Spinning Machine

that causes the arm to swing *inward* toward the chuck, and thus tool *F* is made to follow approximately the line of the spinning form. It should be clear, however, that the operator, by moving the carriage faster or slower toward the chuck, can vary the angle of the path that tool *F* will describe.

After the blank has been placed in position, it is swabbed lightly with tallow, and the operator engages the clutch lever with his foot and causes tool *F* and carriage *G* to advance toward him. At the same time, he turns handwheel *N* and causes the arm to swing inward toward the chuck. It takes three passes of the spinning tool to complete the work satisfactorily. On the first pass he bears very lightly on the carriage handwheel so as to only spin the metal part way into the form. On the second pass, however, he advances the carriage more rapidly and causes the tool to carry the metal almost to the lines of the form. On the third pass he bears still harder on the carriage-operating handwheel and causes the tool *F* to crowd the metal into the form and completely form the shape.

The operator on this machine has become very adept in his work and produces six hundred of these lighting arrester cones in a ten-hour day, which is about five times the output that the best hand spinner could maintain.

Miscellaneous Flat Iron Machining Operations

In the manufacture of electric flat irons at the Pittsfield plant, there are several machining operations of special interest because of the thoroughness with which they are done, coupled with a high rate of production. The tops of flat iron bases are finished by milling on a Becker vertical milling machine as illustrated in Fig. 10. On the table of the machine is a continuously rotating fixture that holds fourteen castings. Each of the seven handwheels operates a wedge that enters between two castings and forces them forward against positive stops on the fixture. The milling is done by a large flat face mill that removes one-sixteenth inch of metal from the face of each casting. Although the fixture rotates continuously, it gives the operator time to remove and insert new castings without stopping the rotation of the table. This method of milling takes care of the facing of the top sides of these castings at the rate of two hundred per hour.

The facing of flat iron clamps is another operation that is done in an unusual manner. The leading illustration shows how this is done on a Conklin dry grinder. This machine is similar to a large disk grinder in principle, but employs solid blocks of emery for the abrasive. These blocks are closely fitted around a six-foot diameter disk and both sides of the disk are similarly fitted. The irons are held in magnetic chucks that are mounted on the work-tables. Levers are used for pressing the work against the grinding disk. The work-holding tables are automatically oscillated while the disk is in rotation. The amount of metal removed is just sufficient to clean up the casting, and two hundred finished pieces per hour is the production of each operator. One of the advantages of this machine is its high cutting capacity which is due to the large diameter of the disk.

Still another facing method that is used on flat iron castings is the operation of grinding on a Blanchard grinder. This is shown in Fig. 12, which represents the machine at work; the water guards have been removed for the sake of clearness. From ten to sixteen flat irons are placed upon the magnetic chuck and about one-thirty-second inch of metal is ground from the face of the castings, leaving the bottom perfectly smooth and true. One operator will face off eight hundred castings in ten hours. The wheel consumption is very low.

The sheet steel covers for flat iron clamps are made by drawing them up three-quarters inch deep in a heavy double-acting drawing press. After drawing, it is necessary to trim off the fin or excess metal around the edge. For this purpose the device shown in Fig. 13 has been made. A lathe has been utilized, upon the spindle of which is a special form of the same shape as the flat iron clamp over which the steel cover is to fit. The punching *A* is slipped over this form and held there by a similarly shaped block mounted on ball bearings on the tailstock. To the left of the form on the spindle is a hardened form *B* that acts as a guide for the shearing roll *C*, and through contact between form *B* and roll *C*, the cutting edge *D* of the roll is kept in the right relation to the left-hand face of the form over which the punching has been placed. Spring pressure at the rear of the cross-slide on which roll *C* is mounted insures the cutting being done properly. Lever *E* withdraws the cross-slide when the work is to be removed. With this device, the flanges of the punchings are quickly and cleanly trimmed.

* * *

FIXED CALIPER GAGES IN MANUFACTURING

The term "interchangeable manufacture" means that all parts are made alike within certain limits. The limits may vary, depending on the class of product and the accuracy required. The extension of the use of limit gages throughout the manufacturing field has produced some wonderful economies, but there is still much that can be done to standardize and improve manufacturing operations. A misconception exists as to the practical limitation of interchangeable manufacturing. It is not necessarily limited to parts made in large quantities, but may be profitably extended to include parts made in small numbers when all dimensions have been fixed.

Many manufacturers believe that limit gages are costly appliances, that they are short-lived and require extraordinary care. It is true that first-class measuring appliances are high priced, but it is not true that the maintenance of modern limit gages is expensive. As a matter of fact, an adjustable limit gage may be maintained at very low cost, and if properly designed its use is not limited to one particular piece. When a part becomes obsolete, the limit gages used in a shop for testing and inspecting may be readjusted for other parts, and so on indefinitely.

The fixed caliper system of gages was introduced in the United States by John Richards when he inaugurated his system in the plant of the present John M. Rogers Works, Gloucester City, N. J., in 1865. This gage system is built around the standard snap and standard plug gage, and the limit snap and limit plug gage. These are divided into three classes as follows: working gages for shop use, inspection gages for final checking, and control gages for testing and controlling all other gages.

Limit gages include two classes, termed tolerance gages and allowance gages. Tolerance gages provide for reasonable error in workmanship, while allowance gages take care of the necessary difference in the sizes of two pieces which have to go together to obtain the quality of fit wanted.

Allowance gages are again divided into four distinct classes, with reference to four distinct types of fits, *viz.*, running, push, driving and force fits. A running fit is that provided for a shaft which must turn easily in its bearing, the necessary allowance for which is dependent on the class of machine. A push fit is employed for parts that may be joined by hand but are not free to rotate. A driving fit is used for parts that must be driven into position with hand hammers or sledges, depending on the size and fit. Force fits are those that are assembled by hydraulic or mechanical presses. Force fits include shrink fits which are made with the same or slightly smaller allowance for assembling by heating the external part and shrinking it into place.

Allowances are nearly always made on the shaft, as it is far easier to vary the size of the shaft than the diameter of the hole. Therefore a standard diameter hole is the starting point in laying out a gaging system. The standard-hole system requires but one set of reamers and one set of internal cylindrical gages, in addition to the set of external limit gages for each kind of fit; whereas, should the standard-shaft system be used, each change of diameter would require a different set of internal cylindrical gages and reamers for the hole. —*Adapted from bulletin published by the John M. Rogers Works.*

* * *

During the year June, 1914 to June, 1915, about 600,000 automobiles were built in the United States, as compared with 445,000 during the preceding year. It is believed that the total production for 1916 will be about 900,000.

LATHE CHUCKS—2*

A REVIEW OF FACEPLATE AND COLLET WORK-HOLDERS

BY JOSEPH HORNER†

CHUCKS which do not resemble the faceplate in primitive outline constitute a very large class. Roughly speaking, they hold small diameters rather than large, and pieces long in proportion to their diameter. The old bell-chuck, Fig. 30, may be taken as typical of the principle, though it is clumsy and awkward to use, and the same result is secured in other ways more efficiently. The standard form of bell-chuck, shown with eight screws in the illustration, is still largely used in Europe. At times the screws are guarded by thickening the metal considerably and sinking the heads into the wall. This chuck is most useful when it is made especially to suit some piece of work that is awkward to hold in any other way. Fig. 31 shows a special bell-chuck with a bushing at the back, and other instances might be illustrated of long work outside the normal range of an ordinary jaw chuck being handled in a chuck of this type. The practice of using laterally adjustable screws for the purpose of tightening is also found in the special brass-finishers' "clambs," Fig. 32 and Fig. 34, to which suitable false jaws are screwed.

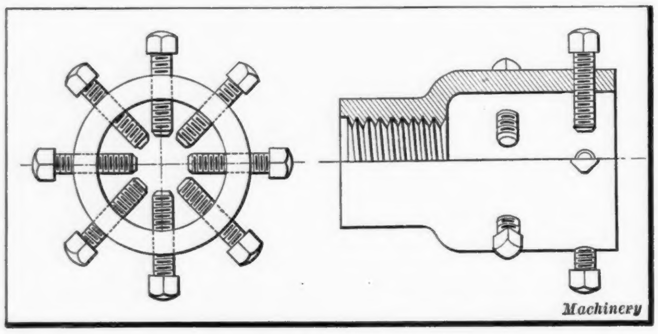


Fig. 30. Standard Design of Bell-chuck

Collet Type of Chuck

The most commonly used and convenient arrangement, however, for gripping pieces that are long in relation to their diameter is the collet type of chuck, employing jaws which are closed in by the action of a taper outside. There are two chief forms, one with loose "grips" or collet segments held by an annular collar, and the other of the spring type which opens of itself when released. A great many British turret lathes are provided with the first-named style, and require the use of a large wrench to tighten and loosen the cap which operates the grips. Sometimes a hand worm-gear drive is used instead, and the action can also be made automatic by means of gears from the headstock. In heavy lathes this becomes essential because of the amount of power required for tightening and releasing. The principle may be observed from Fig. 33, which shows the large collar nut fitting the spindle, the collar engaging with the grooves in the grips. The grips are comprised of a complete collet divided into three portions, so that when the nut is tightened the grips are forced inward and

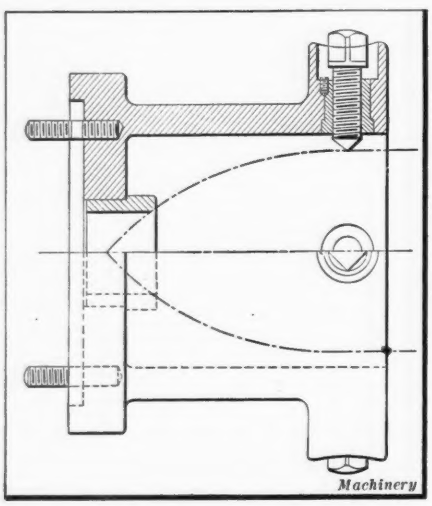


Fig. 31. Bell-chuck with Centering Bushing

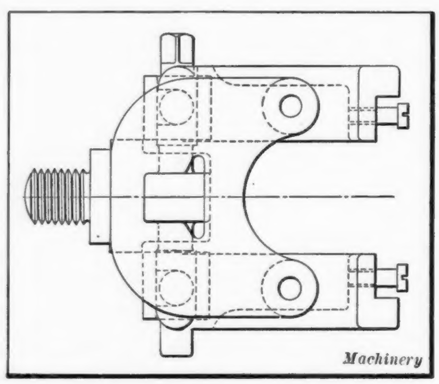


Fig. 32. Self-centering "Clamb"

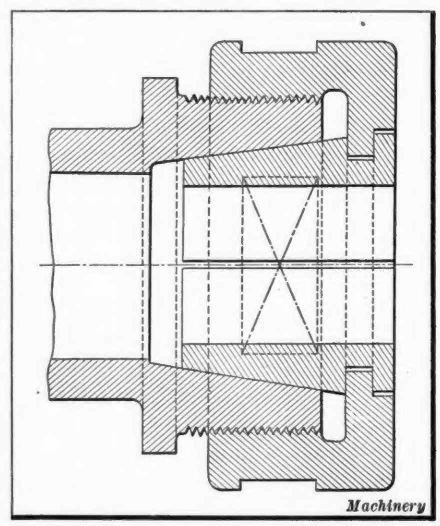


Fig. 33. Collet Chuck operated by Wrench

* The first installment of this article appeared in the March number.

† Address: 45 Sydney Bldgs., Bath, England.

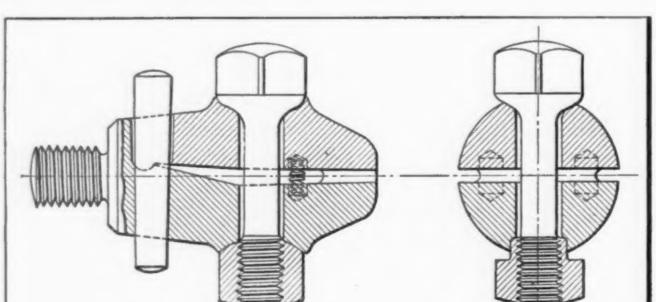


Fig. 34. Brass Finishers' "Clamb"

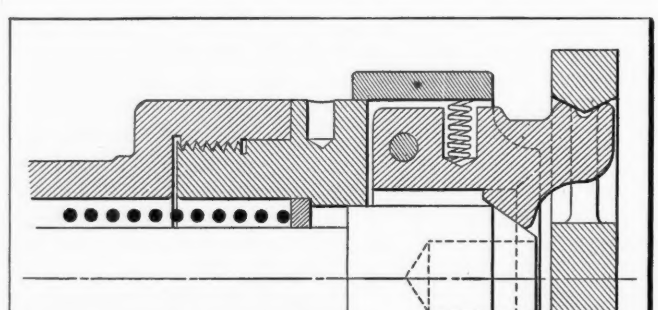


Fig. 35. Special Pivoted Jaws operated by Push-out Rod

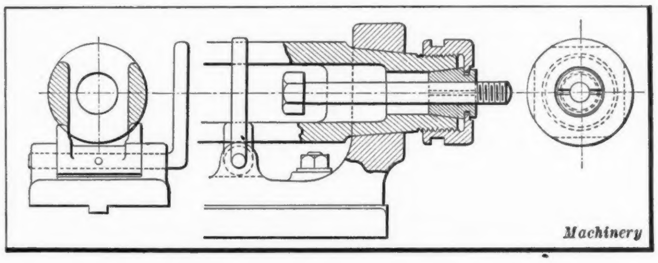


Fig. 36. An Open Spindle, affording Access to the Hand

closed around the bar. In some cases the bore is threaded to hold screwed pieces. Fig. 36 illustrates the "open spindle," having a space for the hand to reach in and push the bar forward, or to receive a head or other enlarged part of the work. The lever with stop blocks is thrown into action when the spindle has to be held immovably while the wrench is in use on the chuck nut. A set of grips with bores covering the desired range is furnished. When more rapid action is desired on a comparatively light chuck a sliding collar is arranged in place of the screwed

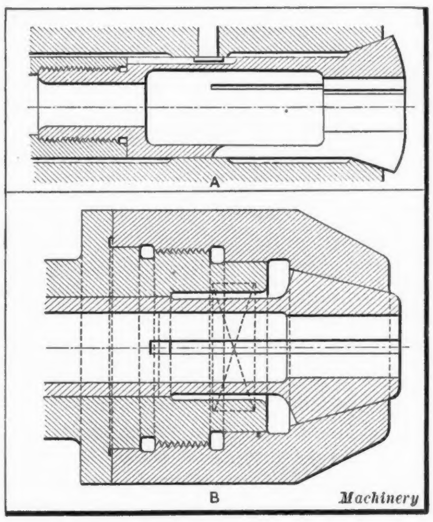


Fig. 37. Split-spring Type of Chuck

nut, and is slid by a lever forward or backward while the spindle is running.

The split chuck is the most popular device for gripping, of the class mentioned, and is fitted to bench lathes, various sizes of turret lathes, and to automatics. The precise mode of operation varies widely according to individual ideas, and in some degree to the size of the lathe. Thus in a watchmaker's or a bench lathe a movement by a handwheel is sufficient, so that the act of turning the wheel also rotates the tube and draws the chuck in by the action of the threaded tail as at *A*, Fig. 37. Tool-room lathes are also arranged to include a draw-in chuck, but in this case when the spindle nose is not bored specially, an adapter is

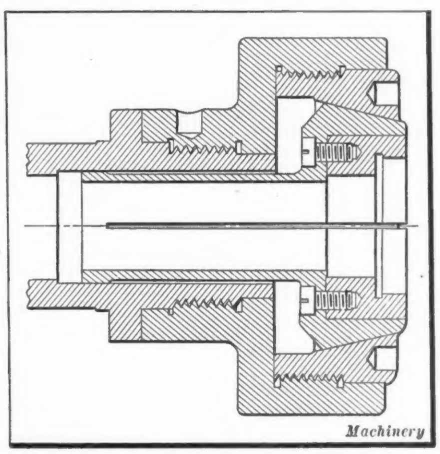


Fig. 38. Extra Capacity Hood and Collet with False Jaws

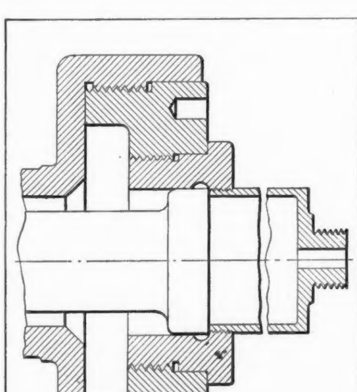


Fig. 39. Adapter Ring and Push-out Rod to hold Threaded Work

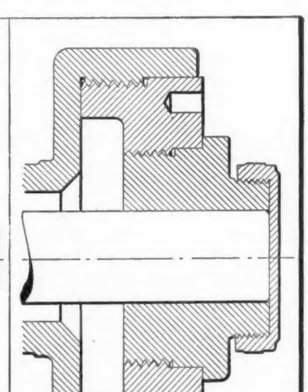


Fig. 40. Internally Threaded Work locked by Push-out Rod

required to act as a closer. Some turret lathes are preferably constructed with a plain bore spindle and an adapter nose screwed on, as shown at *B*, Fig. 37, which illustrates one of the "push-out" variety.

The methods of operation of the split chuck in turret lathes are so varied that it is out of the question to attempt to illustrate this section of the subject adequately. Generally speaking, however, they all depend on some modification of the Parkhurst method of action, comprising toggles opened by a

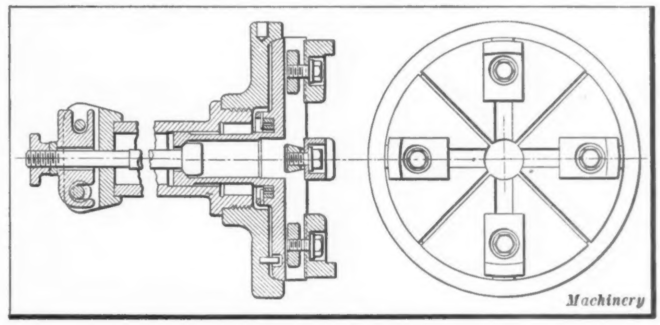


Fig. 41. Split Chuck of Faceplate Type

sliding collar, the toggles acting on the draw-in or push-out tube. The object of the sliding collar is to provide a mechanism that can be operated while the spindle is running, and the collar is slid longitudinally either by a hand-lever, or in automatics by a device operated by cams. Wire or bar-feed mechanisms also offer some complicated details, ranging from the simpler weight feed to the hand or power tube feed, and the more elaborated roller feeds.

The split chuck is capable of a wide range of capacities and capabilities when fitted with suitable liners, collets, or false jaws. These may hold unusual shapes, or sizes beyond the normal capacity of the lathe spindle. Larger hoods, for instance, supply the means of fitting an abnormal chuck, Fig. 38, to which are attached specially shaped liners. The capacity can be still further increased as in Fig. 42 by bringing the false jaws outside. The extreme in this direction is seen in the "stepped," "disk," or "wheel" chucks, Fig. 53, while a handy kind of modification, Fig. 41, combines the action of a split chuck with the jaws of a dog chuck, the jaws being adjustable for concentric or for irregular shapes. The inclusion of special fingers or jaws, as illustrated by the example Fig. 35, is another extensive method of providing for gripping special shapes by the outside or inside, the plunger of the chuck giving the required action for forcing the jaws against the piece. Simple studs or pegs furnish another means of holding work with openings, the studs entering the opening and being pressed laterally by the closing operation. The nose of a collet may be slotted to fit into openings in the work and act in a similar manner. It is not always necessary to exercise a gripping action on screwed objects, and the endwise movement of a plunger is often utilized (see Fig. 39) simply to lock work which has been screwed by hand into the adapter. An internally threaded piece is locked by a plunger, or push-out rod, entering it and forcing it outward to tighten the hold of the threads, as shown in the illustration Fig. 40.

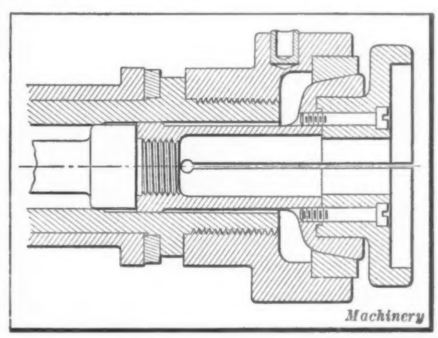


Fig. 42. Extra Large False Jaws in Collet

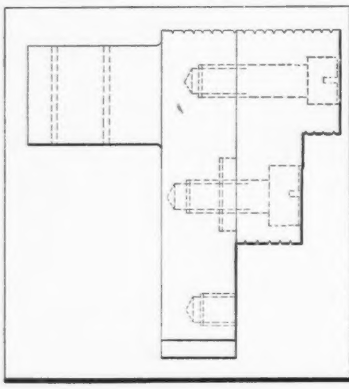


Fig. 43. Reversible False Jaw with Stud

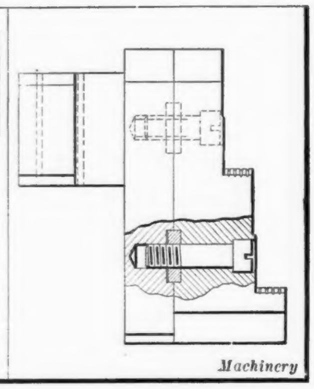


Fig. 44. Reversible Jaw with Dowel Washers

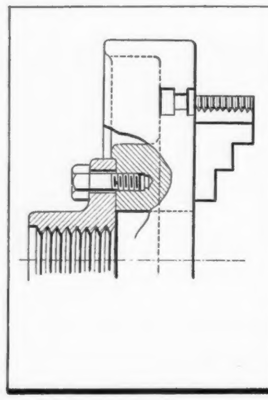


Fig. 45. Ordinary Way of fitting Chuck to Lathe Spindle with Adapter

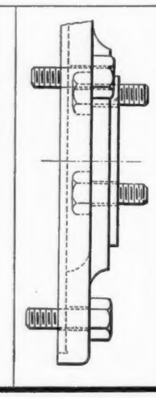


Fig. 46. Adapter to fit Small Chuck to Flanged Spindle

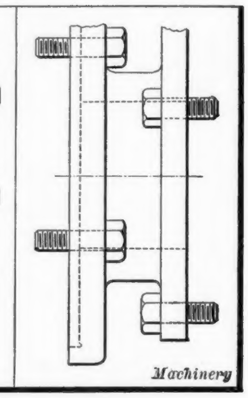


Fig. 47. Flanged Adapter for Flange Nose Spindle

Shapes of Chuck Jaws

Consider now some of the variations in form in which the regular chuck jaws occur. The three common shapes of standard jaws, Fig. 48, are well known, and serve for gripping work up to the largest capacity of the chuck by the outside and by the inside. The form without steps is used chiefly for rods and tubes, where its smooth back is safer. Blank jaws are simply rectangular in outline and are finished to shape according to the work to be held. A frequent practice is that of fitting a separate top or false jaw to a scroll toothed base, Fig. 49, so that it may be cut to outline, and when not wanted another top can be substituted in its place. Alternatively, a false top is screwed to the steps of an ordinary jaw, and cut to outline. The necessity for providing holding means for both inside and outside grips is solved in one of three ways: (1) a separate set of jaws is reserved for each function; (2) the same jaws are reversed in the chuck slots; and (3) separate tops or false jaws are fitted to non-reversible bases, and are turned end for end to reverse. The second practice is easy when the jaws can be run out at the ends (such as in Fig. 14 in the first installment of this article) and the steps are cut off suitably at the corners to adapt them for inside and outside contact. But if the screw and whole nut type of jaw is employed, this is not practical and the false jaw method must be adopted. The false jaw method shown in Fig. 43 is the Union Mfg. Co.'s device, held by a dowel and two screws. Fig. 44, which shows the Skinner chuck, is a variation of the above-mentioned practice, inasmuch as the thrust is received by washers entering half way in jaw and top. Another way is to dovetail the top into the base. Still another is to fit it over the ends of the base, screws being added in each instance. It is not practicable to reverse the jaw in a scroll chuck, because of the curvature of the teeth in the jaw. This can only be done in the special Sweetland jaw, which has lozenge-shaped teeth to fit the scroll either way. Otherwise a false jaw has to be fitted to it, one method being illustrated in Fig. 54—from Whiton practice—with dovetails and a screw. The screw is omitted in the light chucks, and the dovetail joint is sunk to a level below the chuck slot, so that the sides of the latter prevent lateral misplacement. In this case it is necessary to run the jaws out for reversing the tops.

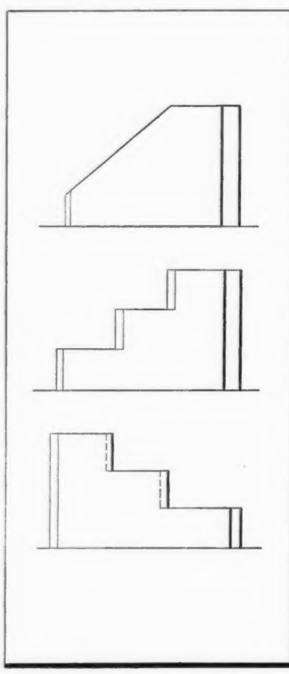


Fig. 48. Common Forms of Jaws

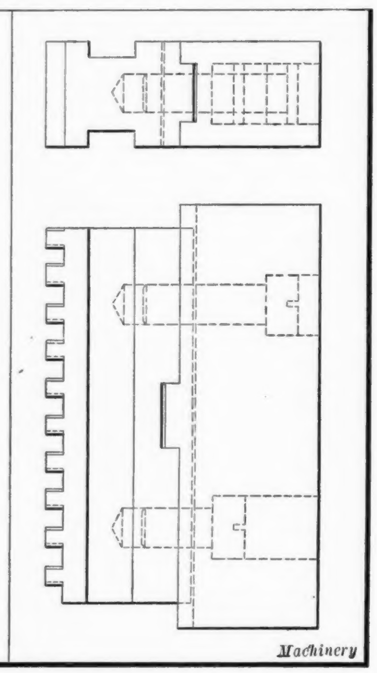


Fig. 49. Jaw with False Top

Jaws grooved or cut out to special forms to match parts of work are very common in the two-jaw or brass-finishers' variety of chuck. It is not necessary, easy or convenient to utilize three or four jaws for this service. The most that is done in three- or four-jaw chucks is to turn a recess on the inside or outside of the jaws to match the cross-section of the work, and to locate and grip it thereby. In the two jaws mentioned, much more is done and the cutting out may resemble a mold or a die, which is made to fit quite accurately the general outline of a small

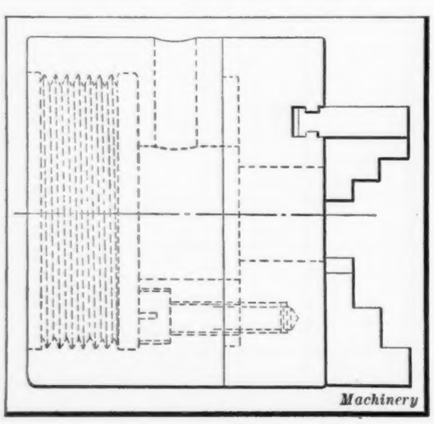


Fig. 50. Adapter for fitting Small Chuck to Large Spindle

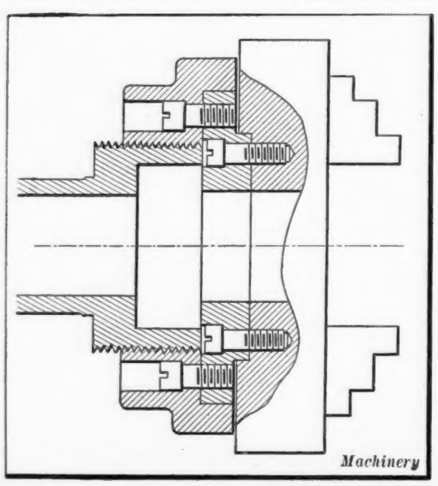


Fig. 51. Small Chuck fitted to Lathe Spindle with Special Adapter

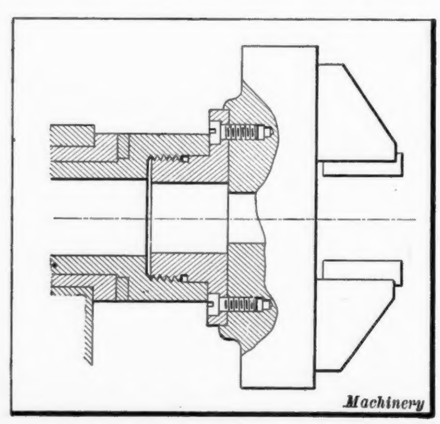


Fig. 52. Chuck with Adapter fitted to Inside of Spindle Nose

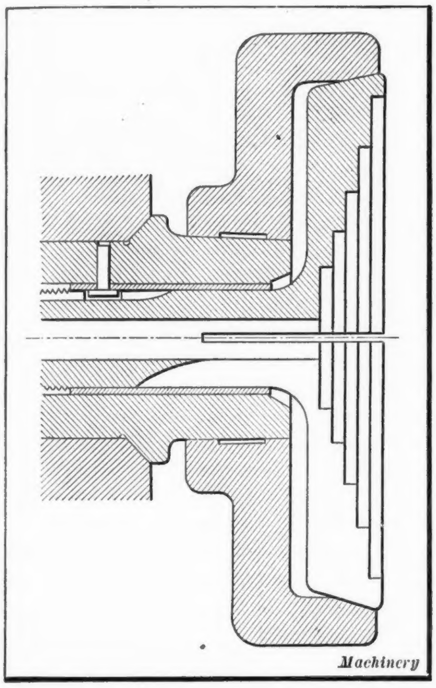


Fig. 53. Large "Wheel" Type of Chuck for holding Disks

casting, thereby holding it very securely. The recessing is done in loose slip jaws which are dovetailed to the real jaws. On the European continent, a chuck of novel design is quite extensively used. It is virtually a two-jaw chuck, but on each jaw is mounted a disk or turret, on the peripheries of which are cut suitable recesses to hold from five to seven different shaped pieces. To grip a different shaped piece, it is only necessary to revolve the disks till the corresponding recesses are opposite one another. This saves set-up time by comparison with the single-purpose slip jaws. Apart from these special two-jaw chucks the normal number of jaws on chucks is three or four (drill chucks excepted). Three jaws should give perfect results theoretically, but actually they do not afford the same power of grip that four do, neither do they get the same general average of the roundness of a slightly irregular piece. On the other hand, a universal chuck with four jaws may not give its full advantage if the work is slightly out of round, because two opposite jaws will do most or all of the work. This is not the case with an independent chuck, since the jaws are all set against the work separately and an equal pressure is insured. An uncommon style of chuck may be mentioned. It is of the regular three-jaw design except that an extra jaw is inserted diametrically opposite one of the other jaws. In this way it may be converted into a two-jaw chuck for work that is suitable. When this is in use, the two flanking jaws are of course unoccupied. More than four jaws are fitted to chucks chiefly when it is desired to get the truest average of a slightly irregular object, and to hold it with the greatest security. Some car-wheel chucks are so provided.

Attachment of Chucks

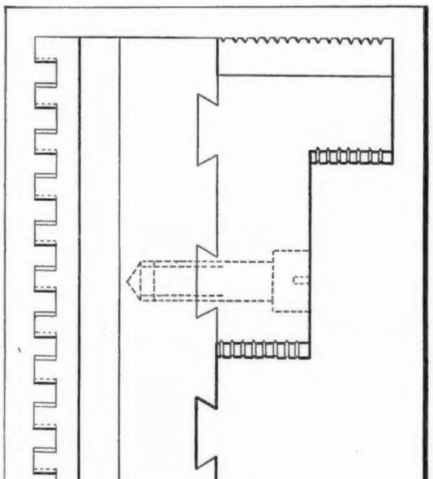


Fig. 54. Dovetailed Reversible Jaw

There is much variety in the methods of fitting chucks to lathe spindles, depending on the type and size. The standard method is to fit a back-plate or adapter threaded to match the spindle nose, and unite this to the chuck with screws or bolts. The recess in the back of the chuck, see Fig. 45, affords accurate centering. To avoid the undue overhang of a heavy chuck, the plate may be reversed, with its boss projecting into the chuck bore. On a large flange nose spindle, an adapter of the kind shown in Fig. 47 is often used, or if the chuck is small the adapter is modified as in Fig. 46. Fig. 50 represents a special adapter for mounting a small chuck on a large spindle, an occasional requirement when large hollow spindle lathes are used. Figs. 51 and 52 are alternative methods of mounting chucks with adapters, that shown in Fig. 52 being screwed inside the spindle nose, which ordinarily is employed for a split chuck.

Direct attachment of chucks, that is, without the intervention of an adapter, is done chiefly in the case of the common jaw chucks. Direct fitting is, of course, done in the case of the small chucks which are screwed over or into the spindle nose, but these are mostly of small capacity. A taper arbor is used for small rod chucks and drill chucks.

* * *

DANGEROUS WAR BUSINESS

Many will make fortunes in the manufacture and sale of war munitions, and many will lose money as a result of undertaking to manufacture products with which they are unfamiliar or owing to conditions over which they have no control. The following extract from a circular letter that was recently sent to the creditors of a company reveals a situation that probably has many parallels:

We regret to be obliged to ask our creditors for a general extension of time for the payment of our accounts.

In explanation we would say that in September, 1915, we entered into a contract for machining 250,000 shrapnel shells to be done at the rate of 1000 to 1200 per day, beginning on the first day of November, 1915. We immediately changed our machines so as to enable us to do the work, but in this work we were at first delayed by the failure of the owners of the work to furnish correct gages and standards, and we were further delayed later by changes made in the specifications and by the failure of the inspectors of the work to arrive and make examinations of the work which had been done, until in the month of January, 1916, a new change was agreed upon in the specifications, not contemplated at the time of the making of the original contract, which necessitated the procurement of six grinding machines. Owing to the present conditions and congestion of orders in the machine making factories, it was found impossible to obtain deliveries of these machines until late in the summer; and owing to these conditions we made arrangements with the owners of the work to furnish us the necessary grinding machines which they have agreed to make and deliver.

Meanwhile with no income we have exhausted our resources and are at the present time shut down. We are assured by experts that we have a good contract and one which if carried to completion would not only pay all our indebtedness but leave a substantial profit for our stockholders. The quality of our product thus far has shown that we are able to do the work satisfactorily and below the figures we estimated when the contract was entered into. All that we need is the time to swing ourselves.

* * *

PECULIARITIES IN MACHINE DESIGN

A study of mechanisms used in machine tools and other machinery often perplexes the mechanical expert somewhat. He is at a loss to know why the designer has used a means for accomplishing a certain action when other simpler and better means were apparently available. The investigator might conclude that the designer was ignorant or foolishly preferred a complicated means rather than the simpler device.

This conclusion seldom would be borne out by fact; the real reason generally lies in the patent office. A design for performing a certain function has been patented and proved to be successful. Competitors have been obliged to get around the patent by resorting to the use of various clumsy and inefficient alternative mechanisms. Years after the patents have expired, the clumsy inefficient mechanisms may remain in use. The concerns interested have invested thousands of dollars in patterns, jigs, tools and fixtures, and rather than sacrifice this investment, they prefer to go on year after year making machines with inefficient features. This condition in machine design is somewhat similar to that with which humanity is afflicted due to the vestigial organ known as the vermiform appendix. Its original function is no longer apparent but it still remains to plague us.

UNUSUAL CYLINDRICAL GRINDING JOB

An unusual grinding job is the finishing of one edge of the steel adding machine part (shown about half size in Fig. 1) on the cylindrical grinder. Practically all work done on a cylindrical grinder is rotated through three hundred and sixty degrees, but this job rotates through only ninety degrees.

The work may be clearly seen in Fig. 2, in the simple holding fixture that goes on the centers of the machine. The corner of this piece is rough-milled before hardening. It

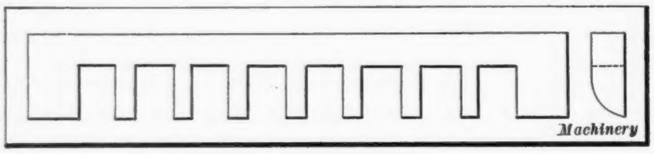


Fig. 1. Adding Machine Part

will be noticed that the surface to be finished is divided into ten sections; this provides a means for clamping the piece on the fixture by dogs that grip the sides of the slots. A bracket is clamped on the front face of the machine in the same way that the steadyrests are attached. This bracket carries a wheel which receives rotation from an overhead drum through the driving belt shown. From the right-hand face of the wheel, there extends a crankshaft that reaches down to the fixture mounted on the centers of the machine. The belt that transmits rotation to work held on centers for ordinary grinding is removed. When the shaft carrying the crank-plate is rotated, it is apparent that an oscillating motion will be given to the fixture on the centers. By lengthening or shortening the throw of the crank, any desired arc of traverse may be obtained. In operation, the machine is started and the work traversed by the wheel in the ordinary way; the fixture, meantime, instead

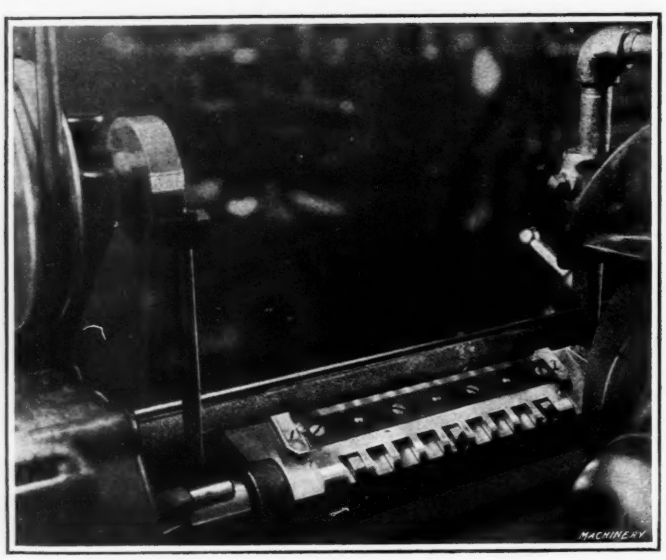


Fig. 2. Grinding Corner of Piece on Cylindrical Grinding Machine

of making a full revolution, simply makes a quarter revolution and returns. By this method the corner surface is ground true and to a better finish than could be obtained in any other way. C.L.L.

* * *

BRAZILIAN COMMERCIAL COMMISSION

Plans are being made in Brazil for the organization of a commercial commission which will visit the United States with the threefold purpose of: first, calling attention of capitalists in the United States to opportunities for investment in public utilities and manufacturing establishments in Brazil; second, increasing the exports from the United States to Brazil by showing what Brazil wants in machinery, textiles and other manufactured articles and by explaining Brazilian requirements in the matter of banking, exchange, customs regulations and transportation; and third, increasing the imports of Brazilian products into the United States.

CASEHARDENING AND CASEHARDENING COMPOUNDS

Casehardening is a carburizing process by which the carbon content of a thin shell or case of iron and low-carbon steel parts is increased so that when heated to a temperature of 1475 degrees F. (800 degrees C.) or higher they will harden when dipped in a cooling bath. Casehardening may be done in a variety of ways, the simplest and quickest being by the use of cyanide of potassium. The cyanide is heated in a pot to the hardening temperature of steel and the parts to be casehardened are immersed until thoroughly heated and are then dipped into a cold water bath as usual. Or the cyanide may be applied to the part to be hardened with tongs while the piece is heated to a low red temperature. After the cyanide has been applied all over, the work is reheated to the hardening temperature and dipped. But cyanide hardening is suitable only for work requiring a thin case— 0.002 inch or less. For a thick case, it is customary to pack the parts in a cast-iron box filled with granulated bone, burnt leather scraps or commercial compounds prepared for the purpose. The box is covered with a tight-fitting lid, sealed to exclude the air, and is heated in a furnace for several hours, depending on the size of the box and depth of case desired. When the required time has elapsed, the box is removed and the contents dumped into a bath. This practice, however, is not the best. Preferably, the box and contents should be allowed to cool down, after which the work is removed, reheated to the hardening temperature, and quenched on a "rising heat." Practice recommended is reheating to about 1650 degrees F., and quenching in warm oil or warm water. The temperature depends on the carbon content of the steel, however. Steel generally used for casehardening contains 0.25 per cent or less carbon and requires a temperature of 1650 degrees F. to toughen the core, which is the object of the first heat. If the carbon content is from 0.15 to 0.20 per cent higher, the reheating temperature should be from 75 to 100 degrees lower. The work should then be reheated to about 1425 degrees F. and quenched in cold water. Large pieces should be heated to a temperature of 25 to 50 degrees higher, but rarely more.

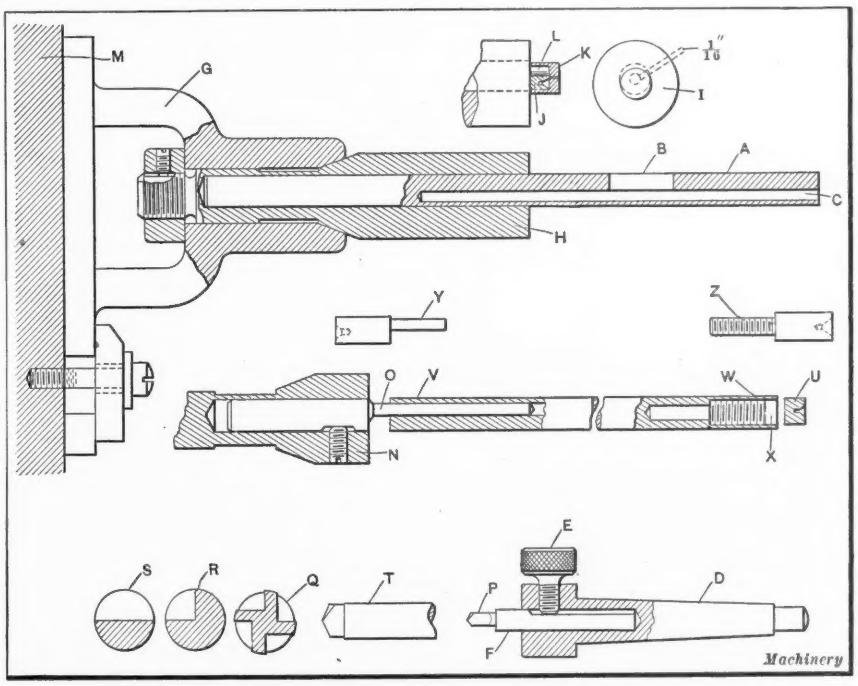
Besides the casehardening materials mentioned, a number of compounds have been placed on the market for which advantages are claimed in the way of cheapness, convenience in use, and depth of case with resulting toughness. It is important to remember, however, when using any casehardening compound that proper heat-treatment is necessary in order to secure satisfactory results. In the following list, are given the names of the commercial compounds for casehardening that have distinctive trade names.

Name	Manufacturer
Achilles	E. F. Houghton & Co., Philadelphia, Pa.
Acme	European Color & Chemical Co., New York City.
Ajax	Montgomery Chemical Works, Inc., Baltimore, Md.
Atlas	European Color & Chemical Co., New York City.
Black Diamond	Rogers & Hubbard Co., Middletown, Conn.
Blaich	Alfred O. Blaich Co., Chicago, Ill.
Bohnite	Case Hardening Service Co., Cleveland, Ohio.
Bull Dog	Rodman Chemical Co., E. Pittsburg, Pa.
Carbo	Rodman Chemical Co., E. Pittsburg, Pa.
Case-Hardo	Thos. Buchanan Co., Cincinnati, Ohio.
Excelsior	European Color & Chemical Co., New York City.
Ferro Case	C. G. Buchanan Chemical Co., Cincinnati, Ohio.
German	European Color & Chemical Co., New York City.
Hardenite	Montgomery Chemical Works, Inc., Baltimore, Md.
Hi-Carbon	Bell & Gossett Co., Chicago, Ill.
Houghton	E. F. Houghton & Co., Philadelphia, Pa.
Hubbard	Rogers & Hubbard Co., Middletown, Conn.
Hydro Carbonated Bone-black	E. F. Houghton & Co., Philadelphia, Pa.
Ideal	Ideal Casehardening Compound Co., New York City
Kasenit	Kasenit Co., New York City.
Keystone	Rodman Chemical Co., E. Pittsburg, Pa.
Laffitte	Phillips-Laffitte Co., Philadelphia, Pa.
Monitor	European Color & Chemical Co., New York City.
Pearlite	E. F. Houghton & Co., Philadelphia, Pa.
Portland	Rogers & Hubbard Co., Middletown, Conn.
Pothard	Carl Nehls Alloys Co., Detroit, Mich.
Standard	Rogers & Hubbard Co., Middletown, Conn.
Sterlingworth	Sterlingworth Charcoal Co., Cambridge, Mass.
Tri B. Pack Comp.	C. G. Buchanan Chemical Co., Cincinnati, Ohio.
Vulcan	Montgomery Chemical Works, Inc., Baltimore, Md.
Woodside	Park Chemical Co., Detroit, Mich.

MACHINING RIFLING BARS ON THE BENCH LATHE*

BY A. H. CLEAVES†

It is the purpose of this article to describe the work of machining rifling bars on the bench lathe. The bars were made of steel and the work involved deep-hole drilling, and eccentric turning and grinding operations. It is not claimed that these bars could not have been machined in some better way, but it happened that the only equipment available at the time was three bench lathes, and the results obtained with these machines were very satisfactory. It is hoped that the following description may prove of value to readers of MACHINERY in suggesting ideas for handling bench lathe work where similar operations have to be performed. In the accompanying illustration the rifling bar is shown at *A*; the cutter is inserted in this bar at *B* and provision is made for adjusting the radial position of the cutter by means of a rod which has a tapered side that engages the bottom of the cutter. This rod is carried in the hole *C* in the rifling bar, which is 4⅞ inches deep by ⅛ inch in diameter. The finished size of the bar is 0.300 inch in diameter, and the hole *C* is 1/16 off center. It is the purpose to describe a fixture designed for drilling this eccentric hole, the work of drilling the hole, and the way in which the final turning and grinding operations were performed to bring the outside of the bar parallel with the hole and still maintain exactly the required eccentricity.



Tools used for drilling, turning and grinding Rifling Bar on Bench Lathe. Tools Q, R, S, and T are shown to an Enlarged Scale

As previously stated, three bench lathes were available for use in machining the rifling bars *A*. Before starting work, these machines were carefully tested and it was found that the beds were comparatively straight, but that the tailstocks were approximately 1/64 inch out of alignment with the headstocks. The following expedient was adopted to correct this inaccuracy. Chucks *D* were made with tapered shanks to fit the tailstocks, and these chucks were provided with thumbscrews *E* to hold the tools. The chucks were next mounted in the tailstocks of the respective bench lathes on which they were to be used and marked in one position, and the holes were drilled and reamed to receive the sockets *F* by means of tools held in the headstock chuck. Brass sockets *F* were next made for each of the drills and reamers that were to be used in drilling the holes *C* in the rifling bars.

The fixture for holding the bar while drilling the hole *C* is shown at *G* in the accompanying illustration; and in passing it may be mentioned that the same type of fixture may be used to advantage on the various classes of lathe, drill press and milling machine work. In the present case the fixture was also used for holding the chuck *H* in the proper position to drill the eccentric hole to receive the rifling bar *A*. The method of locating the chuck in the fixture preparatory to drilling the hole was as follows. The required eccentricity is 1/16 inch as indicated in the end view *I* of the chuck. To provide for obtaining this eccentricity, a projection *J*, 3/16 inch in diameter, was turned on the end of the chuck body while the latter was held on centers so that it was concentric with the lathe spindle. A cap or shell *K* was next made of such a size that the difference between the inside of the cap and the diameter of the projection *J* on the chuck was ⅛ inch; *i. e.*, twice the required eccentricity. After this cap had been made, a plug *L* was turned up to a diameter of exactly ⅛ inch and the cap *K* was then forced over the projection *J* and plug *L*, as shown in the illustration. The fixture *G* was next mounted on the faceplate *M* of the lathe and its position adjusted until the center of the cap *K* coincided with the center of the lathe spindle, as proved by indication on the center of the cap. The chuck *H* was then drilled and reamed to receive the rifling bars *A* which were held in place in the chuck by means of two setscrews that are not shown in the illustration. After the chuck *H* had been completed, the next step was to make a second chuck *N* without altering the setting of the fixture on the faceplate. After this chuck had been finished, an eccentric mandrel *O* was turned up and hardened, after which it was remounted in the chuck *N* and ground to insure accuracy.

The hole *C* was started with a short flat drill *P* which was followed by a twist drill that worked to a depth of 1 inch, after which a boring tool was used for machining the hole to a depth of ¾ inch. A four-lipped reamer *Q* was next employed to finish the hole to the depth reached by the first twist drill. The accuracy obtained with these preliminary operations was highly important because any error introduced up to this point would influence the accuracy of the entire job. In connection with the machining of deep holes of small diameter, it may be mentioned that the writer has never obtained satisfactory results with the so-called "cannon" drills of the form shown at *R* or half reamers of the form shown at *S*. The corners on tools of these types are too easily dulled and too much resistance is offered to the clearance of the chips from the holes. But the reamer *Q* gave very satisfactory results; the ends of the lips of this tool are not rounded and they are backed off on the top just enough to give a free cutting action. A tool of this type is easily "stoned" on the ends of the lips to keep it in good working condition. The writer is prepared to recommend this type of tool for use in reaming deep holes of small diameters. After the hole had been finished to a depth of 1 inch, special No. 31 twist drills 1¾, 2½ and 6 inches in length were used to complete the drilling of the holes to the required depth. These tools were used in conjunction with reamers of full length. If an exceptionally smooth finish had been required, a second reamer would have been used in connection with each drill and the lips of this second reamer would have been rounded.

The tool *T* is one of the most important of those used for drilling the holes. It will be seen that the body of this tool is slightly larger than the cutting point; this body fits closely into the reamed hole and is of sufficient length to re-

* For other articles on bench lathe work and allied subjects published in MACHINERY, see "The Bench Lathe and Its Uses," February, 1912; "Taper Turning on the Bench Lathe," October, 1910; "Accurate Gage Work on the Bench Lathe," May, 1910; and "Jig and Die Work on the Bench Lathe," November, 1909.

† Address: Princes Bay, N. Y.

align the other drills for a depth of 3 or 4 inches. Each of the No. 31 twist drills works to a depth of about 1 inch, and between successive operations of the twist drills the drill *T* was used to maintain the alignment of the hole by re-centering. From three-quarters to one hour was required for drilling hole *C* in each of the rifling bars, and the writer drilled and reamed over ninety of these holes without breaking or choking a drill. The accuracy was sufficient to allow a piece of drill rod 0.0015 inch under size to drop to the bottom of the hole through the force of gravity. Two reamers were broken in reaming the ninety holes referred to, and the cause of this was that the tools were inadvertently started to work under conditions of speed and pressure suitable for the drills, which were too severe for the reamers.

After completing the drilling of the holes in all of the rifling bars, the next step was to finish the outside of the bars to the required diameter; and in performing this operation, precautions had to be observed to insure having exactly the required eccentricity for the hole and also to have the hole parallel with the outside of the bar. For this purpose the chuck *N* was mounted in the fixture—with the position of the fixture on the lathe faceplate unchanged—and the mandrel *O* was mounted in the chuck so as to insure replacing in the same position, but in use, of course, it was placed in the lathe itself. The mandrel is of such a size that it is a wringing fit in the hole *C*, and in preparing to machine the outside of the rifling bars the first step was to mount one of the bars on the mandrel as shown in the illustration. It will be noted that the position of the rifling bar on the eccentric mandrel is reversed in the lathe, with the result that the axis of the bar is brought concentric with the axis of the lathe spindle. When the position of the work had been adjusted so that the outside of the bar ran approximately true, the bar was soldered to the mandrel, after which a centering button *U* was brought near the opposite end of the rifling bar *A* by means of the tail-center. This center was then "sweated" onto the end of the rifling bar. In securing the center in place, great care had to be taken to avoid deflecting the rifling bar, and after it had been soldered in place, the work had to be tested to see that such deflection had not occurred. This was easily determined by backing the tailstock away from the work and rotating the lathe spindle with the outer end of the work free. Under these conditions any disturbance in the alignment of the work can be readily detected.

The next step was to turn the outside of the rifling bar at *V* and *W* to a diameter of 5/16 inch to form bearings for steadyrests. After this had been done, the work was released from the center *U* and mandrel *O* by melting the solder; it was then mounted in a spring chuck and supported by a center at the opposite end, after which the entire outside of the bar was turned to a diameter of 5/16 inch. The next step was to drill and tap the hole *X*, and for this purpose special taps were employed. These were made with an enlarged section between the tap and the straight shank which entered the opening in the collet *D*. The tap was turned by a pin entering holes in the large central part of the tap, the work being held in a chuck and further secured by means of a dog. After finishing the machining of the tapped hole *X*, the plugs *Y* and *Z* were introduced into opposite ends of the rifling bar and carefully centered while the bar was supported in steadyrests on the bearings machined at *V* and *W*. It will, of course, be evident that plug *Y* was soldered to secure it in the desired position. The work was then set up on centers on the grinding machine and ground while soft to a diameter of 0.306 inch, after which it was hardened, straightened and finish-ground to the required diameter of 0.300 inch.

* * *

Holes in castings should be located at a certain minimum distance from the edge of the casting. A drilled bolt hole should be located at least one and one-fourth diameter from the edge of the casting; a cored bolt hole, one and one-half diameter; a drilled rivet hole, one and three-fourths diameter; and a cored rivet hole, two diameters from the edge of the casting.

MORE LIGHT ON THE SELECTION OF A TRADE

BY E. H. FISH*

The choice of an occupation on the part of a boy is a question which has been given deep consideration. The choice depends usually very largely on circumstances. Most boys are thrown or jump into an industry with no consideration whatever as to the consequence. The result is that most of us are trying to rub off enough corners so that we can sit in a round hole without sore elbows. The people who are interesting themselves in vocational guidance are divided into two camps, *i. e.*, those expecting to apply some psychological test to pick out boys who will grow up to fit the proper niches in the hall of fame, and those hoping to present the attractions and objections to the various vocations in such light that boys, and girls too, will make an intelligent selection of their own accord.

I am a little inclined to look askance at any scheme whereby something short of actual work will give a boy a real insight into any industry. A boy may be told all about the machine industry and still be wildly anxious to take up electricity, not realizing in spite of all that may be said to him, that the greater part of electrical work is machine work. The pity is that so many start toward such a goal with every intention of making good, only to find in a few years that the best there is for them is a wireman's job and no promotion. To my mind the safest and most easily carried out plan, though probably the most expensive, is for the boy to be tried out on the job. Then he actually gets his hands on something even if it is nothing more than a live wire, that sets him to thinking; if he is where he can be gently backed into another job if he does not fit the first, there is always a hope that the right one will be found. Of course there are many boys who have such strong tastes that their niche in the world seems to have been prepared for them, but such boys do not enter into the problem we are discussing.

It was with a view to setting forth some of the fundamentals of the most practiced skilled trades that I worked out the accompanying chart, the trades cited thereon covering about 75 per cent of the skilled industries. I have omitted the women's trades, the textile industries and iron and steel manufacture, on the ground that so small a proportion of the workers in those industries need be skilled, that even if a few are very highly skilled, the industry as a whole should not come under that classification. The percentage which all the workers in each industry are of all workers in all of the skilled industries is shown in the second column. Too much reliance should not be placed on these figures, however, as they were taken from Table I of the 1910 Census, which does not appear to agree very faithfully with any of the other tables. I have then picked out the fundamental operations of each of the trades and grouped them under the heads of forging, molding, cutting, fastening, assembling, measuring, etc.

There is more of a resemblance in these fundamental operations than might be suspected at first thought. Out of all these trades the painter is the only man who has no bending to do, that is to his materials. He has to bend himself enough to make up. In fact the painter is practically in a class by himself, and his is the only one of the trades which includes very distinct processes. The molder and the painter are the only ones who have little or no use for a knowledge of the principles of cutting metal or wood, and the painter's method of assembling his wares, or of painting, is entirely his own. Almost the only place where the painter uses the methods of the other trades is in measuring for his layouts for interior decorating, and even there he is more apt to halve a space on a wall by doubling a string than by means of arithmetic. The printer is specially favored by a system of measurement which is chiefly a matter of mental arithmetic, his system of interchangeable type being a measuring system in itself. The blacksmith also has a freak process, that of welding under

* Supervisor of Education Department, Norton Co. and Norton Grinding Co., Worcester, Mass.

TABLE SHOWING PERCENTAGE OF SKILLED WORKERS EMPLOYED IN EACH TRADE AND THE CLASSES OF WORK THEY DO

Trade	Per Cent	Molding, Bending, Drawing and Forging, Malleable or Plastic Material	Cutting	Fastening and Assembling	Measuring
Blacksmith	4.0	Bending, Forming by Pressure and Blows, Welding	Hot and Cold Chiseling, Drilling, Filing, Punching, Shearing, Bolt Cutting	Bolting, Riveting, Welding	Crude—Limits about 0.1 Inch
Boilermaker	0.7	Bending, Riveting, Flanging, Staking and Scarfing	Cold Chiseling, Punching, Shearing, Drilling and Reaming	Bolting, Riveting	Crude—Limits about 0.1 Inch
Mason Stone Cutter Plasterer, etc.	4.7	Modeling Artificial Stone, Plaster Cornices, etc.	Brick and Stone Cutting	Cementing, Bricklaying, Stone Setting	Very Varied in Different Parts of Trade
Cabinet Maker	2.7	Bending Wood, Veneering Curved Forms	Chiseling, Turning, Planing (by hand or with revolving cutter), Sawing, Drilling	Gluing, Nailing, Screwing, Bolting, Joining	Fair—Limits, 0.01 Inch or Closer
Carpenter	30.3	Bending Wood (Usually Cold)	Same as Cabinet Maker but with a Larger Proportion of Hand Work	Same as Cabinet Maker	Framer's Limits—1 to 2 Inches
Printer	3.9	Embossing Press Work	Cutting Borders, Electros, Cutting and Scoring Paper, Cards, etc.	Type Setting, Stone Work, Make Ready.	A System of Interchangeable Units
Machinist	17.3	Bending, Drawing	Turning, Planing, Milling, Drilling, Grinding, Punching, Shearing (cold)	Bolting, Riveting, Thread Fitting	From 0.00025 to 0.002 Inch Limit
Molder	2.0	Shaping Dry and Green Sand, Loam, etc.	Practically None	Ramming Sand, Setting Cores, Chaplets, etc., Wedging Flasks	Usually Very Crude
Painter	5.7	Practically None	Practically None	Brush Work	Limit 0.1 Inch When Laying Out Decorative Work
Plumber and Steam Fitter	2.4	Bending Pipe, Wiping Joints, etc.	Cutting Threads, Pipe, etc.	Soldering, Screwing together of Parts	Very Crude
Sheet Metal Worker.	1.0	Forming, Bending, Cornice, Pipe, etc.	Shearing, Punching, Drilling, Filing, etc.	Bolting, Riveting, Soldering, Spot Welding, etc.	Fair—Limits 0.05 Inch or Closer
Patternmaker	0.4	Bending Wood—Occasionally	Same as Cabinet Maker, but on Soft Woods	Same as Cabinet Maker	Limits 0.01 Inch Plus Considerable Judgment as to Finish and Shrinkage

Machinery

the hammer, though he is not nearly so much in evidence in that work as he was once. Today his heat-treatment processes bid fair to bring him into prominence in a very different way from the men of our fathers' generation.

Other than these idiosyncracies, there is a remarkable unity of processes in the trades. The fundamental principles of molding and forging, cutting, fastening and measuring may be taught with almost entire assurance that they can be carried over from one trade to another. That is, a boy could be given quite varied work at any or all of these trades with the assurance that when, after a year or two of learning to work, he took up with any one of the trades, he would not feel the loss of time. For example, take a very favorite occupation, that of tinkering on an automobile. The boy who has had experience in bolting parts together, taking the necessary measurements for repairs, machining the necessary repair parts, making the patterns for them, bending irons to fit into place, and soldering up the leaks in the tanks, would find that he had been simply getting experience in the fundamentals of any one of the trades that he might take up, except possibly those of painting and printing.

If some serious attempt were made in our schools to teach boys these fundamental processes, not on a play scale but on a real working scale, they would come out vastly better able to make an intelligent choice of a future trade, and much more likely to take hold of it with some degree of intelligence, than the present-day manual training graduate does. The manual training men may be able to show that all the things that they teach have a place in their courses, but it should be realized that there is a tremendous gap between making a thing for the fun of it, and making it to meet the test of the market. The fundamental processes lose all relation to the industries unless they are carried out in a professional manner. The fact that boys of a very tender age can be taught to do work well is something that is already demonstrated. They cannot expect to be mature, and we would not wish them to lose their youth, but they are just at the stage of life when they can imitate good work as well as poor. The unfortunate thing is that in our schools the boys have too great an opportunity to imitate poor work.

* * *

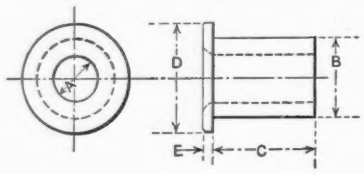
The Ford Motor Co. keeps a check on each department with regard to the number of accidents that occur, and the foreman's ability is judged, to a large extent, by the way in which he maintains a good record in this respect. It is held by the company that the foreman in whose department the work is constantly interrupted by accidents is not the best kind of foreman. The men in charge of departments are, therefore, requested to make sure that every man employed by them understands the work he has to do, and they are expected to be severe with men who are caught doing work in a careless or dangerous way.

JIG BUSHINGS*

STANDARDIZED JIG BUSHINGS AND BUTTONS USED BY GENERAL ELECTRIC CO.

BY R. F. POHLE†

TABLE I. FLANGED BUSHINGS



Size of Drill used for A	B	C	D	E
No. 80 to No. 60	0.126	7/32 to 15/32	7/32	1/16
No. 59 to No. 30	0.251	13/32 to 29/32	3/8	1/16
No. 29 to No. 9	0.376	17/32 to 1 1/32	1/2	3/32
No. 8 to 5/16	0.501	21/32 to 1 13/32	11/16	1/8
21/64 to 7/16	0.626	23/32 to 1 15/32	7/8	1/8
29/64 to 9/16	0.8135	25/32 to 1 17/32	1 1/16	1/8
37/64 to 3/4	1.0015	27/32 to 1 27/32	1 1/4	1/8
49/64 to 7/8	1.1265	27/32 to 1 27/32	1 3/8	5/32
57/64 to 1	1.314	27/32 to 1 27/32	1 9/16	5/32
1 1/64 to 1 1/8	1.439	1 3/32 to 1 27/32	1 11/16	3/16
1 9/64 to 1 1/4	1.564	1 3/32 to 1 27/32	1 13/16	3/16
1 17/64 to 1 3/8	1.689	1 3/32 to 1 27/32	1 15/16	3/16
1 25/64 to 1 1/2	1.814	1 3/32 to 1 27/32	2 1/16	3/16
1 33/64 to 1 5/8	1.939	1 11/32 to 2 3/32	2 3/16	3/16
1 41/64 to 1 3/4	2.127	1 11/32 to 2 3/32	2 3/8	1/4
1 49/64 to 1 7/8	2.252	1 11/32 to 2 3/32	2 1/2	1/4
1 57/64 to 2	2.377	1 11/32 to 2 3/32	2 5/8	1/4
2 1/64 to 2 1/8	2.502	1 11/32 to 2 3/32	2 3/4	1/4

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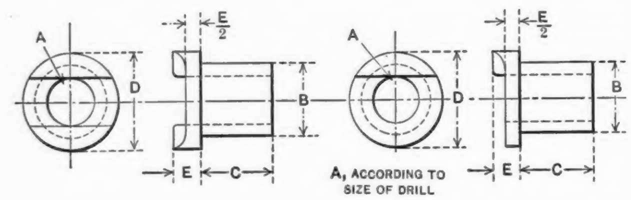
TABLE II. MILLED SEAT BUSHINGS



B	C	D	E
0.376	17/32 to 1 1/32	1/2	1/8
0.501	21/32 to 1 13/32	11/16	5/32
0.626	23/32 to 1 15/32	7/8	3/16
0.8135	25/32 to 1 17/32	1 1/16	3/16
1.0015	27/32 to 1 27/32	1 1/4	3/16
1.1265	27/32 to 1 27/32	1 7/16	1/4
1.314	27/32 to 1 27/32	1 11/16	9/32
1.439	1 3/32 to 1 27/32	1 7/8	9/16
1.564	1 3/32 to 1 27/32	2	5/16
1.689	1 3/32 to 1 27/32	2 1/8	5/16
1.814	1 3/32 to 1 27/32	2 3/8	11/32
1.939	1 11/32 to 2 3/32	2 5/8	11/32
2.127	1 11/32 to 2 3/32	2 3/4	11/32
2.252	1 11/32 to 2 3/32	3	3/8
2.377	1 11/32 to 2 3/32	3 1/8	3/8
2.502	1 11/32 to 2 3/32	3 1/4	7/16

Machinery

WHEN accurate work is necessary, the bushings should support the cutting tool to within one diameter of the tool from the work. If a 5/16-inch drill is used, the end of the bushing should not be more than 5/16 inch from the work, and it may be carried to within 1/8 inch of the work. Bushings should never be brought up too close to the work with the object of carrying the chips up through the bushing. It is much better to provide other means in the jig for the removal of the chips.

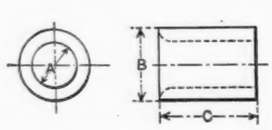
The headed or flanged bushing, Table I, is preferred by many tool designers as a lining bushing, whenever it is possible to utilize it. The flange prevents the bushing from being forced through the hole under the action of the cutting tool. If it is desired to have the head of the bushing flush with the surface of the jig, this can be accomplished by counterboring the jig sufficiently to lower the head below the surface. Headless bushings, Table III, should only be used when the wall of the jig is so thin that it will not allow of counterboring. A special type of flanged bushings is also used as seats for supporting rough work requiring a three-point bearing. In this case they are milled as shown in Table II.

Slip bushings, Table IV, are employed when several operations are to be performed through the same lining bushing. For example, when it is desired to drill and ream a hole and to finish a boss or spot around the hole while the work is still in the jig, a lining bushing is selected that will guide a counterbore 1/16 inch larger than the boss to be finished. A slip bushing is then made to guide the drill, the body of which is a sliding fit in the lining bushing. Another slip bushing is made for the reamer which is also a sliding fit in the lining bushing. The slip bushing walls may have any thickness, providing they are not too thin. Should the conditions require bushings with too thin walls, the counterboring operation in the jig must be abandoned and some different method of procedure adopted. It is generally necessary to lock slip bushings when they are used for reamers 1/2 inch in diameter or less; otherwise they are likely to rotate with the reamer.

The shape of the work frequently requires bushings of considerable length in order to carry the cutting tool close to the work. When the length exceeds four diameters of the tool to be guided, the bushing presents considerable friction surface. A length equal to two diameters of the cutting tool is sufficient for a bearing surface in the bushing. The remainder of the length of the hole in the bushing may be counterbored or relieved. The end that should be relieved is, of course, that which is furthest from the work into which the tool is to be guided.

Screw bushings, Tables V and VI, are generally avoided when accurate work is required. There must be a certain amount of clearance in the ordinary tapped hole, and a threaded bushing is likely to be out of true on that account. Sometimes, however, it happens that no other type of bushing can be used for the work in hand.

TABLE III. HEADLESS BUSHINGS



Size of Drill used for A	B	C
No. 80 to No. 60	0.126	7/32 to 15/32
No. 59 to No. 30	0.251	13/32 to 29/32
No. 29 to No. 9	0.376	17/32 to 1 1/32
No. 8 to 5/16	0.501	21/32 to 1 13/32
21/64 to 7/16	0.626	23/32 to 1 15/32
29/64 to 9/16	0.8135	25/32 to 1 17/32
37/64 to 3/4	1.0015	27/32 to 1 27/32
49/64 to 7/8	1.1265	27/32 to 1 27/32
57/64 to 1	1.314	27/32 to 1 27/32
1 1/64 to 1 1/8	1.439	1 3/32 to 1 27/32
1 9/64 to 1 1/4	1.564	1 3/32 to 1 27/32
1 17/64 to 1 3/8	1.689	1 3/32 to 1 27/32
1 25/64 to 1 1/2	1.814	1 3/32 to 1 27/32
1 33/64 to 1 5/8	1.939	1 11/32 to 2 3/32
1 41/64 to 1 3/4	2.127	1 11/32 to 2 3/32
1 49/64 to 1 7/8	2.252	1 11/32 to 2 3/32
1 57/64 to 2	2.377	1 11/32 to 2 3/32
2 1/64 to 2 1/8	2.502	1 11/32 to 2 3/32

Machinery

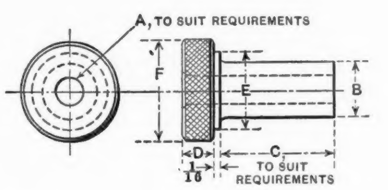
Jig Buttons

Pins or buttons used as seats or stops for castings, forgings, or other work having a rough exterior, where it is necessary to have a three-point bearing for both seating and stopping, are shown in Tables VII, VIII and IX. If the work must be supported against the action of cutting tools at more than three points, it is

* The tables of standards given in this article embody the practice of the General Electric Co., at Lynn, Mass. These standards have been developed for the company by R. F. Pohle, who is in charge of the tool designing department.

† Address: General Electric Co., Lynn, Mass.

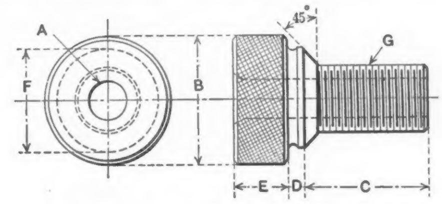
TABLE IV. SLIP BUSHINGS



B	D	E	F
0.1285 to 0.196	3/16	3/8	1/2
0.199 to 0.3125	1/4	1/2	11/16
0.328 to 0.4375	5/16	11/16	7/8
0.453 to 0.5625	7/16	7/8	1 1/16
0.578 to 0.750	1/2	1	1 1/4
0.7656 to 0.875	1/2	1 1/8	1 3/8
0.8906 to 1.000	9/16	1 1/4	1 9/16
1.0156 to 1.125	5/8	1 3/8	1 11/16
1.1406 to 1.250	5/8	1 1/2	1 13/16
1.2656 to 1.375	11/16	1 5/8	1 15/16
1.3906 to 1.500	11/16	1 3/4	2 1/16
1.5156 to 1.625	3/4	1 13/16	2 3/16
1.6406 to 1.750	3/4	2	2 3/8
1.7656 to 1.875	3/4	2 1/4	2 1/2
1.8906 to 2.000	13/16	2 3/8	2 5/8
2.0156 to 2.125	13/16	2 3/8	2 3/4

Machinery

TABLE V. ALIGNING SCREW BUSHINGS



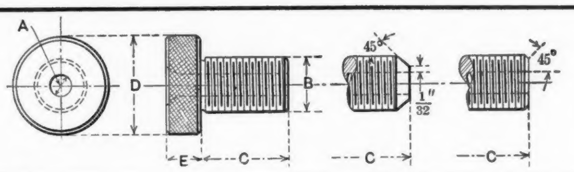
A and C, according to requirements

B	D	E	F	G Diameter and Number of Threads per Inch
7/8	1/8	5/16	11/16	1/2—13
7/8	1/8	5/16	11/16	9/16—12
1	5/32	5/16	7/8	5/8—11
1 1/4	3/16	5/16	1	3/4—10
1 3/8	3/16	3/8	1 1/8	7/8—14
1 1/2	3/16	7/16	1 1/4	1 —14
1 5/8	3/16	7/16	1 7/16	1 1/8—12
1 7/8	1/4	1/2	1 5/8	1 1/4—12
2	1/4	9/16	1 3/4	1 3/8—12
2 1/4	1/4	5/8	2	1 1/2—12
2 1/2	1/4	11/16	2 3/16	1 5/8—10
2 3/4	1/4	3/4	2 3/8	1 3/4— 8
3	1/4	3/4	2 1/2	1 7/8— 8
3 1/4	1/4	7/8	2 3/4	2 — 8

Machinery

necessary to make one of the points adjustable. The jig button shown in Table VII is used when the work has fairly large surfaces for seating. Jig edge buttons are used when the abutting surface is of comparatively thin section. The type shown in Table IX is used as a stop-pin for drop-forgings. It presents a line contact to the work at an angle equal to the draft of the forging dies. It is essential to know where the forging die for each piece is parted, before commencing to design tools for the forging, in order that the buttons may be located to the best advantage.

TABLE VI. SCREW BUSHINGS

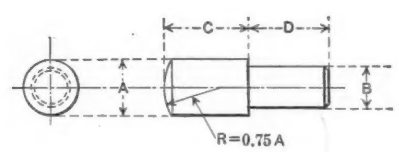


B Diameter and Number of Threads per Inch	D	E	B Diameter and Number of Threads per Inch	D	E
1/2—13	7/8	5/16	1 1/4—12	1 5/8	9/16
9/16—12	7/8	5/16	1 3/8—12	1 3/4	5/8
5/8—11	1	3/8	1 1/2—12	1 7/8	5/8
3/4—10	1 1/8	7/16	1 5/8—10	2 1/8	11/16
7/8—14	1 1/4	1/2	1 3/4— 8	2 1/4	3/4
1 —14	1 3/8	1/2	1 7/8— 8	2 1/2	3/4
1 1/8—12	1 1/2	9/16	2 — 8	2 5/8	13/16

Machinery

A and C according to requirements.

TABLE VII. JIG BUTTONS

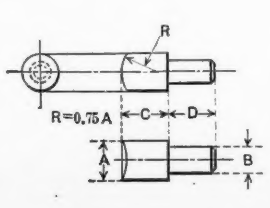


A	B	C	D	A	B	C	D
1/4	0.1885	3/16 to 5/16	1/4	9/16	0.4385	3/8 to 7/8	9/16
5/16	0.1885	3/16 to 7/16	3/8	5/8	0.501	3/8 to 7/8	5/8
3/8	0.251	1/4 to 1/2	3/8	11/16	0.564	3/8 to 7/8	5/8
7/16	0.3135	1/4 to 5/8	7/16	3/4	0.6265	1/2 to 1	3/4
1/2	0.376	5/16 to 11/16	1/2	..	......	....	..

Machinery

It is well known that fires are often caused by the spontaneous combustion of rags soaked in oil. Fires have also been caused by chemical reactions that produced impure phosphoretted hydrogen or phosphine. That gasoline is a dangerous liquid to handle near open lights is well known, but the fact that it may be fired by static electricity sparks produced by its own flow under certain conditions is not generally known. Recent fires caused by the explosions of gasoline while being poured into motor car tanks indicate that there is an unsuspected danger in the act. When the liquid flows from a cock into the funnel, the funnel should be grounded if covered by a chamois filter. The Moline Automobile Co., East Moline, Ill., had two fires recently as a result of gasoline being fired by static electricity. The gasoline was pumped to a filling station through a long pipe line which leads through a duct beside an asbestos covered steam pipe. The gasoline became warm and static electricity accumulated in the pipe. When the tank on a motor car was being filled, an explosion occurred by the ignition of the gasoline fumes by a spark that jumped from the cock to the funnel.

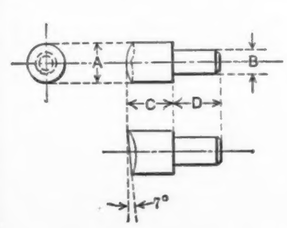
TABLE VIII. JIG EDGE BUTTONS



A	B	C	D
1/4	0.1885	3/16 to 5/16	1/4
5/16	0.1885	3/16 to 7/16	3/8
3/8	0.251	1/4 to 1/2	3/8
7/16	0.3135	1/4 to 5/8	7/16
1/2	0.376	5/16 to 3/4	1/2
9/16	0.4385	3/8 to 7/8	9/16
5/8	0.501	3/8 to 7/8	5/8
11/16	0.564	3/8 to 7/8	5/8
3/4	0.6265	1/2 to 1	3/4

Machinery

TABLE IX. JIG DRAFT BUTTONS



A	B	C	D
1/4	0.1885	3/16 to 5/16	1/4
5/16	0.1885	3/16 to 7/16	3/8
3/8	0.251	1/4 to 1/2	3/8
7/16	0.3135	1/4 to 5/8	7/16
1/2	0.376	5/16 to 11/16	1/2
9/16	0.4385	3/8 to 7/8	9/16
5/8	0.501	3/8 to 7/8	5/8
11/16	0.564	3/8 to 7/8	5/8
3/4	0.6265	1/2 to 1	3/4

Machinery

TRAINING THE APPRENTICE

THE IMPORTANCE OF EMPHASIZING THE TIME ELEMENT IN SHOP WORK

BY T. H. ALVORD*

"You can teach a boy a trade, but you can't teach him the value of time." A few months ago this criticism of apprentice work was made by a manufacturer to James F. Johnson, superintendent of the State Trade School located in Bridgeport, Conn. No doubt the belief of scores of men was voiced in this comment, because it is true that a large percentage of labor, in whatever field, does not appreciate the inevitable relation between time and efficiency. Very few, either in the training school or in the shop, ever stop to think that a waste of only one minute by each member of a force of 5000 men, for example, means a total loss of over eighty hours. A habit of conserving time is probably one of the most difficult to form.

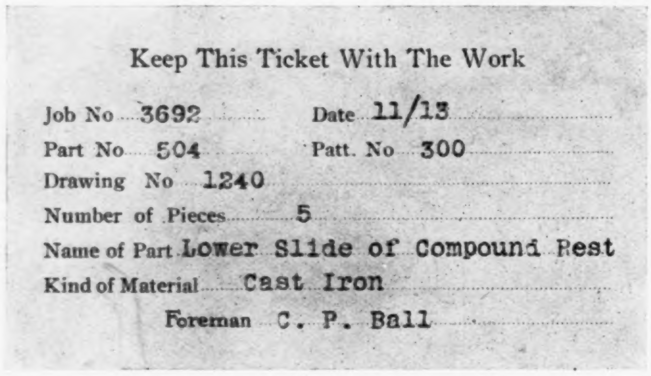

Keep This Ticket With The Work
Job No 3692 Date 11/13
Part No 504 Patt. No 300
Drawing No 1240
Number of Pieces 5
Name of Part Lower Slide of Compound Rest
Kind of Material Cast Iron
Foreman C. P. Ball

Fig. 1. Job Ticket that is filled out when Work is assigned to Student

Mr. Johnson realized the pertinency of the criticism, but did not acknowledge its truth. On the other hand, he set about evolving some sort of system which might be applied to trade school methods, and which would impress upon the boy the value of his minutes from the manufacturer's standpoint and the necessity of filling each one with definite, purposeful labor. The result was the development of a system, the basis of which Mr. Johnson calls the "apprentice rating card." When a job is assigned to a boy, a ticket (Fig. 1) is filled out and attached to a clip on his "tote box," and this ticket stays with the work until it is completed. As a certain drawing is usually called for, the boy goes to the listed rack and finds it, and with the tote box, ticket and blueprint, proceeds to the assignor of work, who gives him oral directions and such other explanations as are necessary for a thorough understanding of the task. In addition, he punches on another ticket (Fig. 2) the operations required on the particular piece of work and the approximate journeyman's time that it should take for completion, also punching on the back of the same ticket (Fig. 3) the time by the clock when the job was begun. The boy then places the ticket in the rack opposite his number, where it remains until the job is completed.

Fig. 2. Operations to be performed and Approximate Journeyman's Time

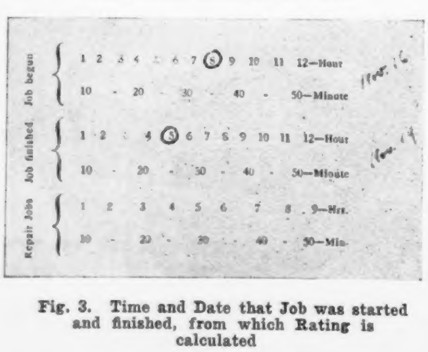


Fig. 3. Time and Date that Job was started and finished, from which Rating is calculated

After the work is finished, the boy takes it with the blueprint and his tickets to the assignor, by whom it is inspected and criticized. The time of completion is then punched on the back of the ticket, Fig. 3. The time when the work was begun subtracted from this gives the actual number of hours and minutes consumed in doing the piece of work. This figure is entered on the front of the card (Fig. 2). The next step is to obtain the apprentice's rating or percentage of efficiency, which is accomplished by dividing the approximate journeyman's time which the work should take, as suggested by the assignor, by the actual time consumed by the boy. This percentage the apprentice calculates and enters upon his ticket, which is then slipped into a box and goes to the superintendent for inspection.

Of the 4800 hours required in the Trade School course, about one-fourth are spent in related technical work. As a part of this special work, the boy enters in a book (Fig. 4) the details of each day's shop work, and then he figures out and plots his

Period from to 19

Date	Job No.	Description of Work	Est. Time	Act. Time	%	Remarks
11/19	3692	Lower Slide Comp. Rest	20	30	66	

Fig. 4. Book in which Record of Shop Work is kept

curve of efficiency for the week. In this way he has before him in graphic form a most readable account of all his work, an inspiration to himself and an aid to his parents or teachers

Fig. 5 shows the efficiency curve of Machine Apprentice No 83 for the month of November. His percentage ranges from 50 to 72, giving an average of 61 per cent for the month, though the rating for the particular job described in the tickets shown herewith is 66 per cent. (Note circle.) This time system worked out by Mr. Johnson has proved to be highly satisfactory and has attracted considerable attention from public school and trade school men who have seen it in operation or to whom it has been explained. Its merit lies in the three principal results—all very practical and vital—which are obtained through its use: first, the apprentice learns how his time on a job compares with that of an experienced journeyman; second, the apprentice learns to conserve his time; third, the problem of discipline is practically eliminated.

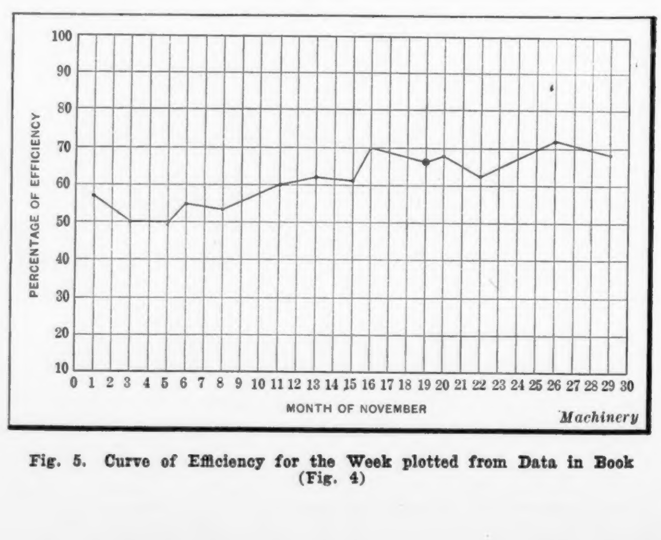
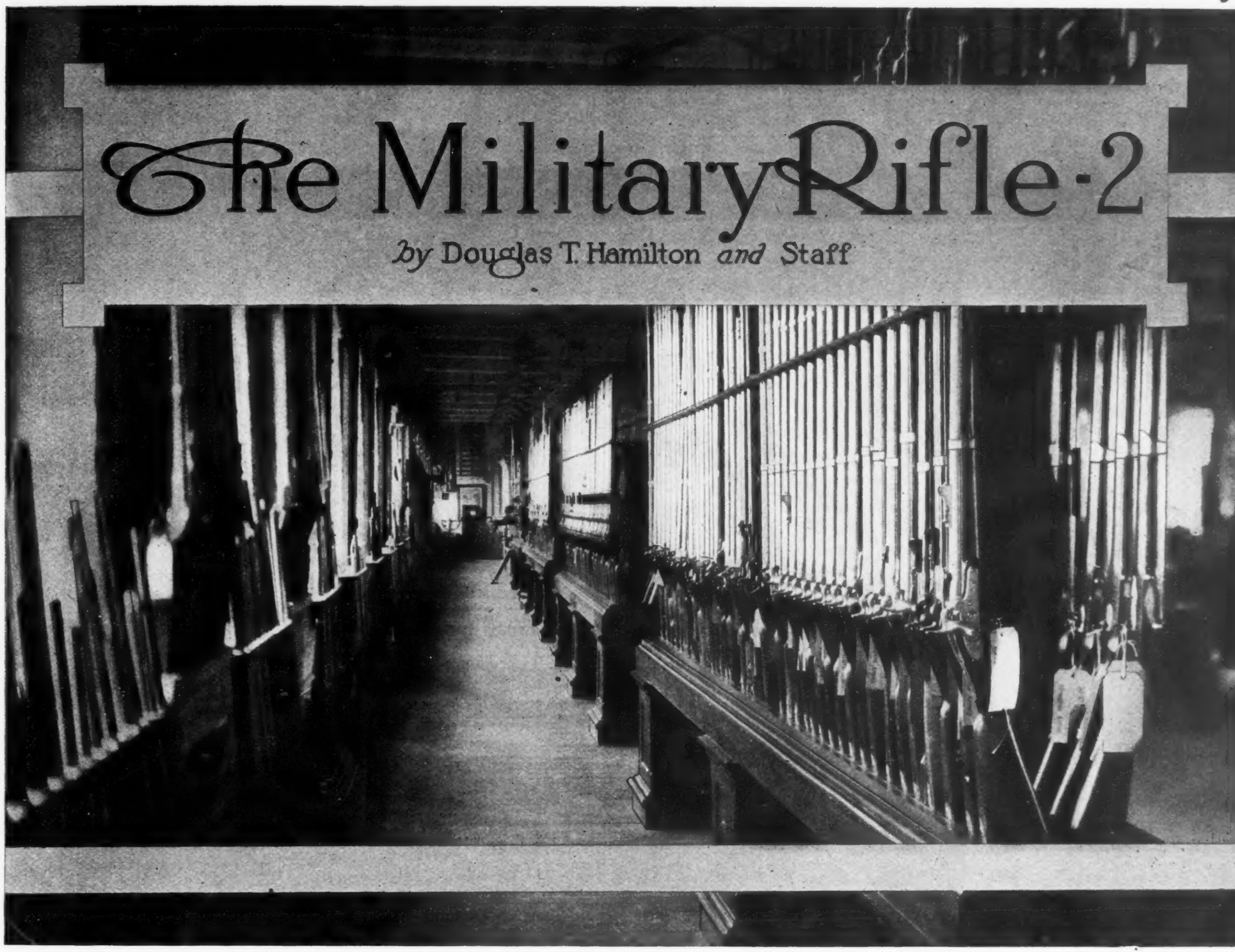


Fig. 5. Curve of Efficiency for the Week plotted from Data in Book (Fig. 4)

* Address: Commercial Department, Bridgeport High School Bridgeport, Conn.

The Military Rifle-2

by Douglas T. Hamilton *and* Staff



THE Spanish Mauser military rifle, which has formed the basis of this article, is of simple design, and nearly all of the parts are made solid or from one piece, instead of being riveted together as they are in some of the other military rifles. While this may increase the number of machining operations required, it makes a more rigid and a smoother working rifle. In the previous installment of this article, the machining operations on the barrel, receiver, bolt, etc., were outlined. In the following, the methods of manufacturing the magazine and trigger guard, rifle stock, and some of the smaller parts are described. Table IV has been repeated because some of the information that it contains refers to the parts described in the following.

TABLE IV. LIST OF RIFLE PARTS GIVING SYMBOLS USED IN SPECIFYING MATERIAL, TREATMENT AND FINISH

No. of Part	Name of Part	Kind of Material	Specification Symbol	Treatment and Finish
1	Barrel	Steel forging	45-120	An-Pi-Po-Br
2	Front sight	Steel	15-72	Po-Bn
3	Front sight base	Steel	15-72	Po-Bn
4	Front sight base screw	Steel	15-45	Po-Bn
5	Rear sight base	Steel forging	15-72	An-Pi-Po-Bn
6	Cleaning rod	Steel	15-45	Use as mach'd
7	Rear sight leaf	Steel	15-72	Po-Bn
8	Rear sight leaf spring	Steel	39-80	Ha-Po-Te 750° F.
9	Rear sight leaf spring screw	Steel	15-45	Po-Bn
10	Rear sight leaf pin	Steel	120-22	Po-Bn
11	Rear sight slide	Steel	15-72	Po-Bn
12	Rear sight slide catch	Steel	15-72	CH-Po-Bn
13	Rear sight slide catch pin	Steel	120-22	Ha-Po-Te 600° F.
14	Rear sight slide catch spring	Music wire	57-45	ST
15	Rear sight slide catch stop screw	Steel	15-45	Po-Bn
16	Receiver	Steel forging	32-120	An-Pi-PH-Po-Bg
17	Retaining bolt	Steel	15-72	CH-Po-Bn
18	Retaining bolt spring	Steel	39-80	Ha-Po-Te 750° F.
19	Ejector	Sheet steel	100-32	Ha-Te 600° F.
20	Ejector fulcrum screw	Steel	120-22	Ha-Te 600° F.
21	Bolt	Steel forging	32-120	An-Pi-PH-Po-Bg-Po
22	Bolt plug	Steel forging	32-120	An-Pi-PH-Po-Bn
23	Cocking-piece	Steel	32-120	PH-Po-Bn
24	Striker	Steel	118-28	Ha-Te 450°-Po
25	Extractor	Steel	39-80	Ha-Te 750°-Po
26	Extractor collar	Steel	39-80	Ha-Te 750°-Po
27	Main spring	Music wire	57-45	ST
28	Safety lock	Steel forging	75-35	An-Pi-Ha-Te 600°-Po-Bn
29	Magazine and trigger guard	Steel forging	15-72	An-Pi-Po-Bg
30	Magazine floor-plate	Steel forging	15-72	An-Pi-Po-Bn
31	Floor-plate catch	Steel	15-72	CH
32	Floor-plate pin	Steel	120-22	Ha-Te 600° F.
33	Floor-plate spring	Music wire	57-45	ST
34	Magazine platform	Steel forging	15-72	An-Pi-CH-Po-Bn
35	Magazine spring	Steel ribbon	100-32	Ha-ST 740°-Cl
36	Stock	Wood	W	Oi
37	Hand guard	Wood	W	Oi
38	Butt plate	Steel forging	15-72	Po-Bn
39	Sear	Steel	75-35	Ha-Tu-Te 600° F.
40	Trigger	Strip steel	75-35	Po-Ha-Po-Te
41	Sear pin	Steel	120-22	Ha-Po-Te 600° F.
42	Sear spring	Music wire	57-45	ST
43	Trigger pin	Steel	120-22	Ha-Po-Te 600° F.
44	Stock mortice band	Sheet steel	14-45	Po-Bn
45	Guard screw, front	Steel	15-45	Po-Bn
46	Guard screw, rear	Steel	15-45	Po-Bn
47	Guard screw, bushing	Steel	15-45	Use as machined
48	Butt plate screw, lower	Steel	15-45	Po-Bn
49	Butt plate screw, upper	Steel	15-45	Po-Bn
50	Butt sling swivel	Steel	15-45	Bn
51	Butt sling swivel block	Steel	15-72	Po-Bn
52	Butt sling swivel pin	Steel	120-22	Ha-Te 600° F.
53	Butt sling swivel block screws (two)	Steel	15-45	Po-Bn
54	Lower band	Steel forging	15-72	An-Pi-Po-Bn
55	Lower band spring catch	Steel forging	75-35	An-Pi-Ha-Te 600° F. Po-Bn
56	Lower band swivel	Steel	15-45	Po-Bn
57	Lower band swivel screw	Steel	15-45	Po-Bn
58	Lower band swivel screw nut	Steel	15-45	Po-Bn
59	Upper band	Steel forging	15-72	An-Pi-Po-Bn
60	Upper band spring catch	Steel forging	75-35	An-Pi-Ha-Te 600° F. Po-Bn
61	Upper band nose plate	Sheet steel*	14-45	Po-Bn
62	Upper band nose plate pin	Steel	120-22	Ha-Te 600° F.

Machinery

* Electrically welded.

THE magazine and trigger guard (see Fig. 47) is drop-forged from a $1\frac{7}{8}$ by $\frac{3}{4}$ inch rectangular hot-rolled bar of gun steel. Owing to the large amount of material to be displaced it is impracticable to complete this part in one drop-forging operation, and two heats are necessary. The first drop-forging consists in "breaking down" the bar and distributing the material to the desired points. A second drop-forging operation is then accomplished, after which the forging is heated for trimming and then annealed and pickled. The first machining operation consists in milling the bottom surface for locating in drilling and reaming the guard screw holes which, in connection with the bottom surface, act as locating and gaging surfaces in subsequent operations. For additional details on feeds, speeds, and production, see Table XXIV. The sequence of operations is illustrated in Figs. 48 to 53.

Operation 1: Forge, Rough.—The rough-forging operation is performed by an 800-pound drop-hammer. Two forging operations are necessary on account of the large amount of material to be displaced. The bar for rough-forging is heated to from 1850 to 1900 degrees F.

Operation 2: Forge, Finish.—This operation, which calls for a second heat to about 1900 degrees F., is done by a 1200-pound drop-hammer.

Operation 3: Trim.—Owing to the shape of this part the trimming must be done hot, and a third heat of about 1200 degrees F. is necessary. The trimming punch is made from a phosphor-bronze casting to prevent distortion from the heat, which would occur if the punch were made of steel.

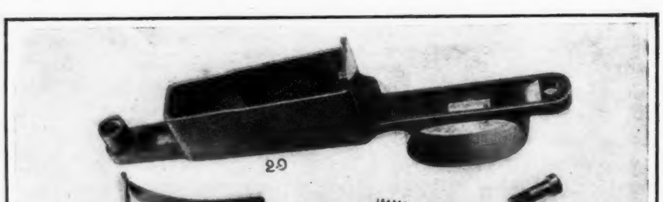


Fig. 47. Spanish Mauser Magazine and Trigger Guard and Parts

Operation 4: Anneal and Pickle.—See "Specifications for Rifle Barrels" in the April number of MACHINERY under the headings "Anneal" and "Pickle."

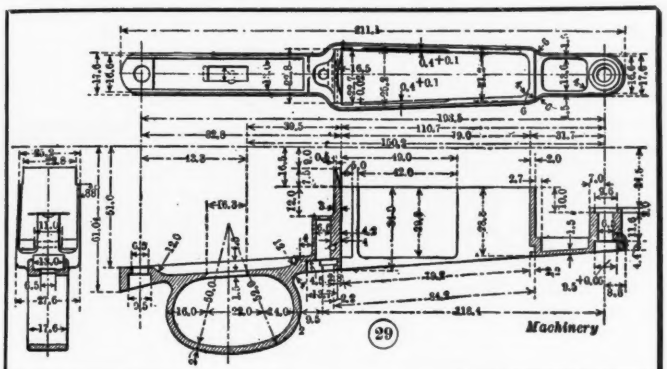
Operation 5: Mill Bottom and Flat Over Rear Guard Screw Hole.—This is the starting point in the sequence of machining operations, and the surface must be carefully machined in order to provide a sufficiently accurate locating point for machining and gaging in subsequent operations. The fixture is arranged to hold two pieces, and is provided with a rigid clamping mechanism, as well as liberal clearance for chips and for the flash on the forging. The cutters are made of high-speed steel, and the long cutter has spiral teeth which are notched to break up the chips.

Operation 6: Spot, Drill, and Ream Guard Screw Holes.—This operation is accomplished on a four-spindle sensitive drilling machine, using a special jig for holding the work. These holes must be accurately finished, as they form the locating points for most of the subsequent operations. The limit for diameter of these holes is $\pm$ 0.00025 inch.

Operation 7: Mill Right- and Left-hand Sides of Magazine.—This is accomplished on a Lincoln type milling machine, using a special fixture that holds two pieces. The work is milled on each side, locating from the guard screw holes and using an adjustable stop that comes up against the lower portion. The teeth of the cutters are cut at a helix angle of 15 degrees, and are nicked in order to break up the chips.

Operation 8: Mill Top, Ends, Front of Boss and Top and Angle of Plunger Lock Boss.—This is done on a Lincoln type milling machine, using a

TABLE XXIV. OPERATIONS ON MAGAZINE AND TRIGGER GUARD—PART NO. 29



Oper. No.	Operation	Mach. Used	Tool or Fixture	Speed, Surface Feet per Min.	Feed per Rev., Inches	Hourly Product per Mach.	Machs. per Operator
1	Forge, rough	800-pound drop-hammer	Forge dies	..	..	45	1
2	Forge, finish	1200-pound drop-hammer	Forge dies	..	..	45	1
3	Trim	Punch press	Punch and die	..	..	80	1
4	Anneal and pickle	Annealing furnace	......	..	..	25	See text
5	Mill bottom and flat over rear guard screw hole	Lincoln type mill. mach.	Spec. fixt. holds two pieces	60	1/16	60	2
6	Spot, drill and ream guard screw holes	4-spindle sensitive drill. mach.	Spec. jig	50-75	Hand	45	1
7	Mill right- and left-hand sides of magazine	Lincoln type mill. mach.	Spec. fixt. holds two pieces	60	1/16	30	3
8	Mill top, ends, front of boss and top and angle of plunger lock boss	Lincoln type mill. mach.	Spec. fixt. holds two pieces	60	1/16	50	2
9	Mill left side and corners	Lincoln type mill. mach.	Spec. fixt. holds two pieces	60	1/16	20	2
10	Mill right side and corners	Lincoln type mill. mach.	Spec. fixt. holds two pieces	60	1/16	20	2
11	Mill sides of magazine back of ribs	Hand mill. mach.	Spec. fixt. holds one piece	70	3/64	45	1
12	Counterbore, drill and ream catch lock pin hole	3-spindle sensitive drill. mach.	Spec. jig	50-65	Hand	25	1
13	Hollow-mill and face front guard screw boss	2-spindle sensitive drill. mach.	Spec. jig	60-65	Hand	50	1
14	Drill, ream and counter-bore floor-plate catch hole and drill for front lightening recess	6-spindle sensitive drill. mach.	Spec. jig	50-65	Hand	25	1
15	Spline-mill magazine opening	P. & W. spline mill. mach.	Spec. fixt.	80	0.005	4	4
16	Broach magazine opening	Lapointe duplex broach. mach.	Spec. fixt. Spec. broach	5	..	40	1
17	Profile catch lock boss, top of guard and front lightening cut	Profiling machine	Spec. fixt.	70	Hand	30	1
18	Profile inside of guard and round corners	Profiling machine	Spec. fixt.	70	Hand	25	1
19	Profile outside of guard and round corners	Profiling machine	Spec. fixt.	70	Hand	20	1
20	Profile front and rear end angles	Profiling machine	Spec. fixt.	70	Hand	20	1
21	Profile floor-plate lock slots	Profiling machine	Spec. fixt.	70	Hand	30	1
22	Mill clearance slot in top of guard	Hand mill. mach.	Spec. fixt. with former	70	Hand	25	1
23	Mill clearance bevel on magazine rib	Hand mill. mach.	Spec. fixt.	70	Hand	65	1
24	Mill slot for trigger	Hand mill. mach.	Spec. fixt.	70	Hand	60	1
25	Profile magazine clearance	Profiling machine	Spec. fixt.	70	Hand	55	1
26	Oscillate mill clearance at rear of magazine opening	Hendey oscillating milling machine	Spec. fixt.	..	0.010" per osc.	55	1
27	Broach trigger slot	Punch press	Spec. fixt.	..	..	100	1
28	C.bore front and rear guard screw holes	3-spindle sensitive drill. mach.	Plate jig	60-65	Hand	70	1
29	Stamp	Bench work	Hand stamps	..	..	250	1
30	File corners and burr	......	......	..	..	10	1
31	Polish	Polishing lathe	Leather covered wheels	5000	..	6-8	1
32	Blue	American "bluing" gas furnace	......	..	..	20	..

special fixture that holds two pieces. This fixture has special clamping jaws and is so constructed that the locating pins can be forced up into the work from beneath by the action of a cam lever. The cutters are made of high-speed steel, with the center cutter nicked to break up the chips.

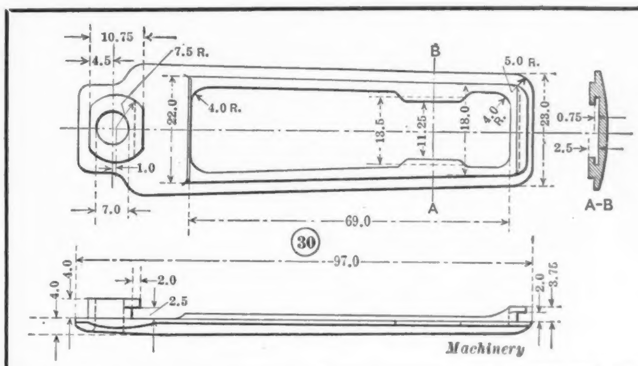
Operation 9: Mill Left-hand Side and Corners.—This operation is accomplished on a Lincoln type milling machine, using a special fixture that holds two pieces. The fixture is provided with adjustable stops located beneath the work to relieve the pressure of the cut on the locating pins. The cutters are made of high-speed steel and have nicked teeth.

Operation 10: Mill Right-hand Side and Corners.—This is similar to Operation 9.

Operation 11: Mill Sides of Magazine Back of Ribs.—This operation is accomplished on a hand milling machine, using a special fixture that holds one piece.

Operation 12: Counterbore, Drill and Ream Catch Lock Pin Hole.—This is accomplished on a three-spindle sensitive drilling machine, using a special jig of the box invertible type, in which the work is located from the guard screw holes and clamped against the bottom by two quick-acting clamps. Removable slip bushings are used in the jig. The milling counterboring is done on each side of the piece with an

TABLE XXV. OPERATIONS ON MAGAZINE FLOOR-PLATE—PART NO. 30



Oper. No.	Operation	Mach. Used	Tool or Fixture	Speed, Surface Feet per Min.	Feed per Rev., Inches	Hourly Product per Mach.	Machs. per Operator
1	Drop-forge and trim	800-pound drop-hammer	Forging dies Trim. punch and die	..	..	50	1
2	Anneal and pickle	Anneal furn. Pickling bath	......	..	..	60	See text
3	Mill bottom surface and ends, rough	Lincoln type mill. mach.	Spec. vise jaws; hold two pieces	60	0.032	80	2
4	Mill top surface, rough	Lincoln type mill. mach.	Spec. vise jaws; hold two pieces	60	0.032	80	2
5	Mill right-hand edge	Lincoln type mill. mach.	Spec. vise jaws; hold six pieces	60	0.040	120	2
6	Mill left-hand edge	Lincoln type mill. mach.	Spec. vise jaws; hold six pieces	60	0.040	120	2
7	Profile magazine spring clearance, rough and finish	Two-spindle profiling mach.	Spec. fixt. and formers	70	Hand	30	1
8	Profile locating ledge and locking lugs, rough and finish	Two-spindle profiling mach.	Spec. fixt. and formers	70	Hand	50	1
9	Profile front and rear locking lug slots, rough and finish	Two-spindle profiling mach.	Spec. fixt. and formers	70	Hand	40	1
10	Profile magazine locking spring T-slot	One-spindle profiling mach.	Spec. fixt. and formers	70	Hand	60	1
11	Mill bottom, finish	Lincoln type mill. mach.	Spec. fixt. holds two pieces	70	0.020	80	2
12	Mill contour on lower front and rear ends	Hand mill. mach.	Spec. fixt. and form. plate	70	Hand	60	1
13	Drill and countersink floor-plate catch clearance hole	Two-spindle drilling mach.	Drill jig	60	Hand	75	1
14	Profile entire edge outline	One-spindle profiling mach.	Spec. fixt. and form. plate	70	Hand	60	1
15	Stamp	Bench work	Hand stamps	..	Hand	250	1
16	Polish	Polishing lathe	Leather cov. wheels	5000	..	80	1
17	Blue	Niter bath	......	..	..	See text	

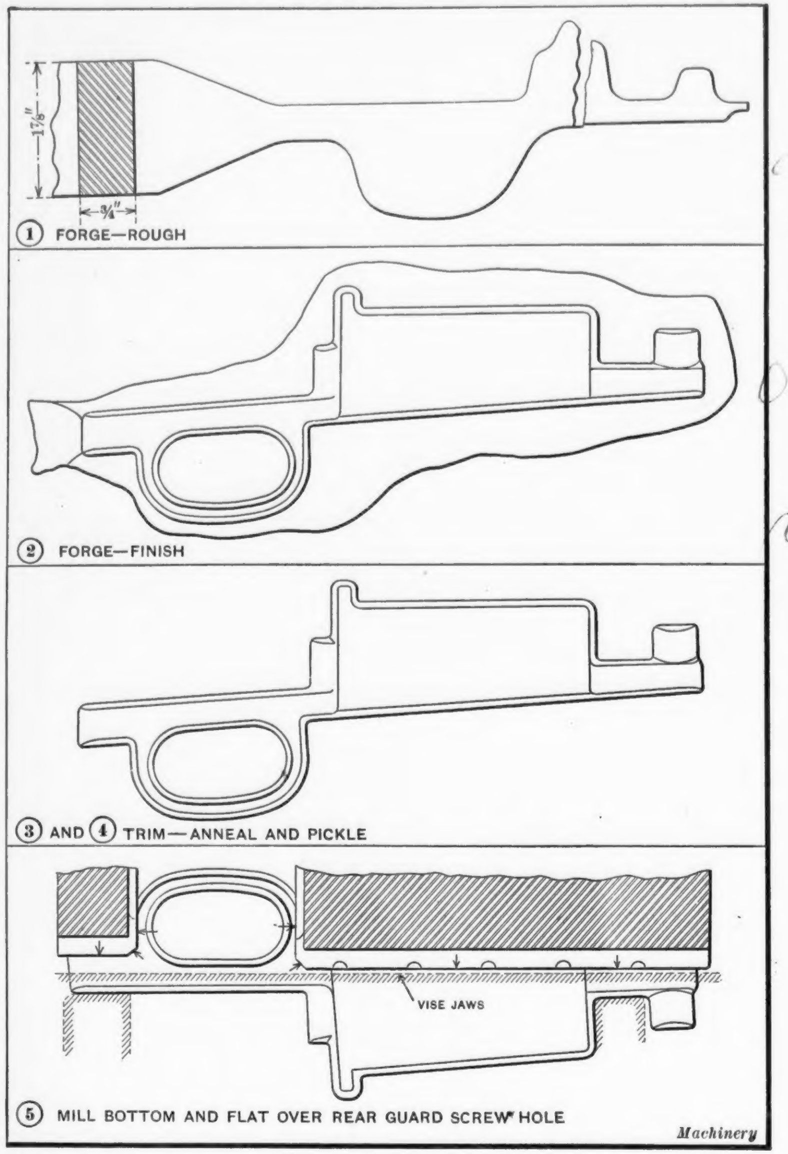


Fig. 48. Operations on Magazine and Trigger Guard

end-mill, which prepares the piece so that the drill will start properly.

Operation 13: Hollow-mill and Face Front Guard Screw Boss.—This operation is accomplished on a two-spindle sensitive drilling machine using a box jig. Roughing and finishing hollow-mills are used.

Operation 14: Drill, Ream and Counterbore Floor-plate Catch Hole, and Drill for Front Lightening Recess.—This is done on a six-spindle sensitive drilling machine, using a box jig with slip bushings. Feet are provided on two sides of the jig so that the holes can be drilled from one side, the jig inverted, and the reaming done from the other side.

Operation 15: Spline-mill Magazine Opening.—This operation is accomplished on a Pratt & Whitney spline milling machine, using special cutters of the fish-tail type having four teeth, instead of the former two-tooth type. A special fixture is used that is supplied with sliding clamps for quickly inserting and removing the work.

Operation 16: Broach Magazine Opening.—This is performed on a Lapointe duplex broaching machine, using a special broach, ground to the required form, and a special fixture for holding the work.

Operation 17: Profile Catch Lock Boss, Top of Guard, and Front Lightening Cut.—This operation is accomplished on a two-spindle profiling machine, using roughing and finishing cutters, the finishing cutter working only on those surfaces where a radius is required. The fixture used is provided with adjustable roughing and finishing former blocks.

Operation 18: Profile Inside of Guard and Round Corners.—This is performed on a two-spindle profiling machine, using a fixture similar to that used for Operation 17.

Operation 19: Profile Outside of Guard and Round Corners.—This is done in a similar manner to Operation 18.

Operation 20: Profile Front and Rear End Angles.—This operation is accomplished on a two-spindle profiling machine, using roughing and finishing cutters.

Operation 21: Profile Floor-plate Lock Slots.—This is accomplished on a two-spindle profiling machine, using a special fixture that holds one piece. Two cutters are used, one of the end milling type for roughing out the clearance for the floor-plate lock slot, and the other of the T-type for milling the locking slots.

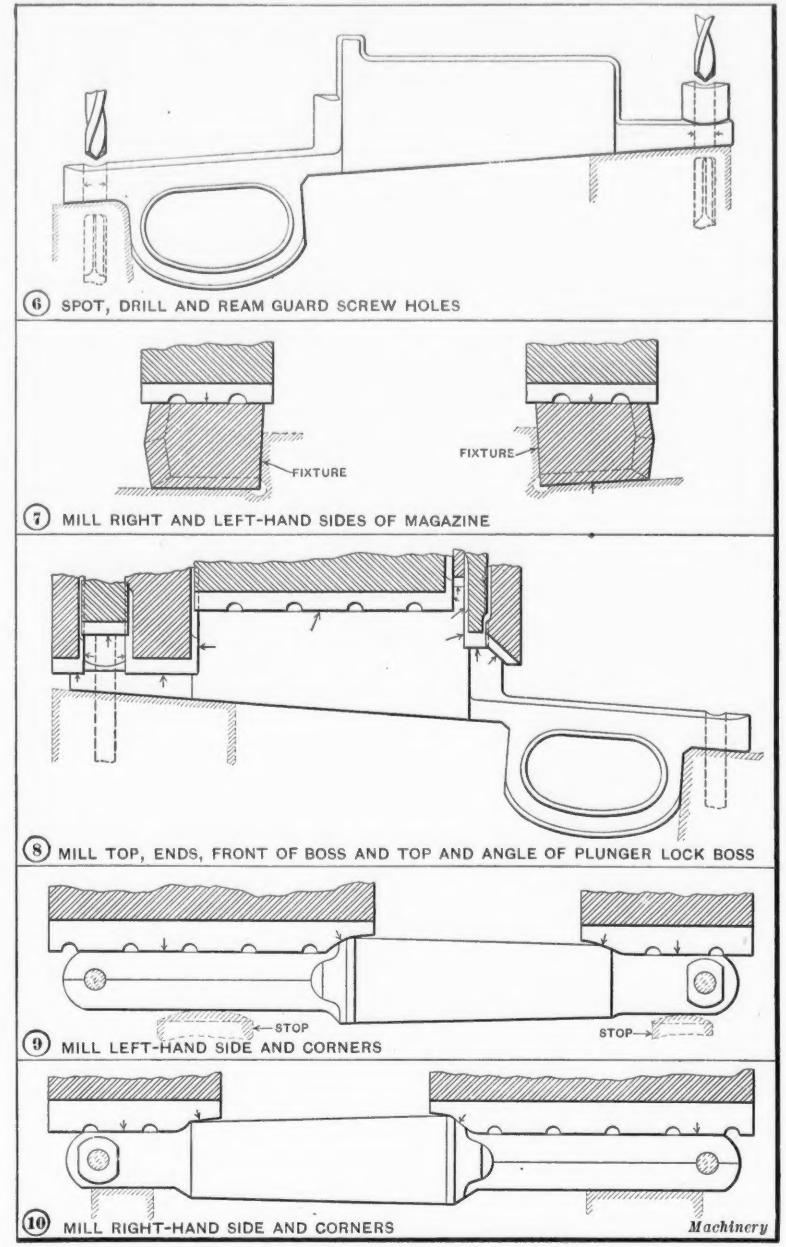


Fig. 49. Operations on Magazine and Trigger Guard (Continued)

Operation 22: Mill Clearance Slot in Top of Guard.—This is done on a hand milling machine, using a fixture that holds one piece. The

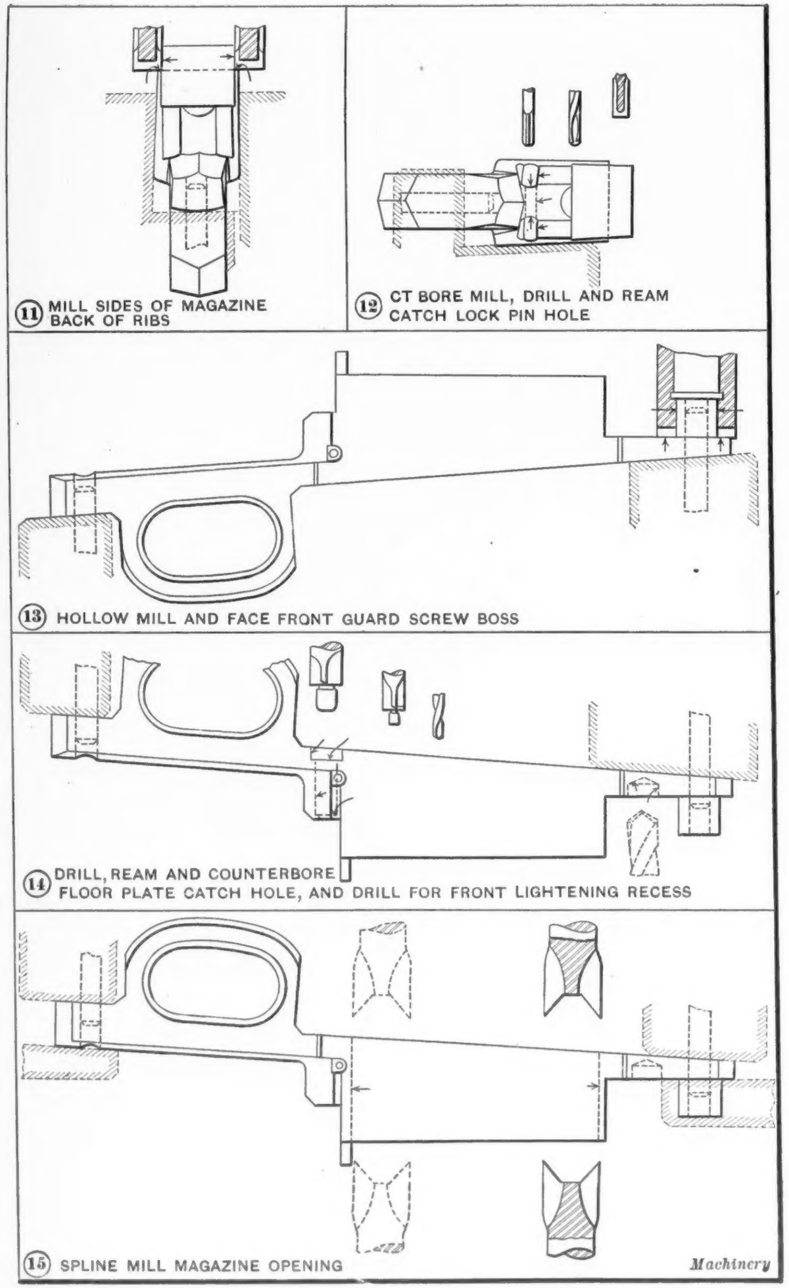


Fig. 50. Operations on Magazine and Trigger Guard (Continued)

fixture is provided with a former plate on which a hardened and ground roller on the spindle rides. This plate controls the movement of the cutter when finishing the shallow cut at the end. The cutter does not have teeth on the sides.

Operation 23: Mill Clearance Bevel on Magazine Rib.—This is accomplished on a hand milling machine, using a special fixture that holds one piece. The cutter is tapered to provide for adjustment and for maintaining the proper radius.

Operation 24: Mill Slot for Trigger.—This operation is accomplished on a hand milling machine, using a special fixture that holds one piece. The cutter is dropped down into the work, without any traverse movement of the table.

Operation 25: Profile Magazine Clearance.—This is performed on a one-spindle profiling machine, using a special fixture in which provision is made for holding the piece rigidly to prevent chatter. The thin walls on the sides make it necessary to clamp the work from the sides with a metal to metal contact.

Operation 26: Oscillate Mill Clearance at Rear of Magazine Opening.—This operation is accomplished on a Hendey oscillating milling machine provided with a special fixture for holding the work and supporting it at the sides to prevent chatter. The cutter is made with close-spaced teeth, and cuts in both directions.

Operation 27: Broach Trigger Slot.—This is performed on a punch press, using a special block fixture on which the work is located from the trigger guard and is additionally supported at the front end.

Operation 28: Counterbore Front and Rear Guard Screw Holes.—This operation is accomplished on a three-spindle sensitive drilling machine, using a jig provided with feet on two sides.

Operation 29: Stamp.—This is a hand operation and consists in stamping the number on the part.

Operation 30: File Corners and Burr.—This is a hand operation and consists in removing all burrs and sharp corners.

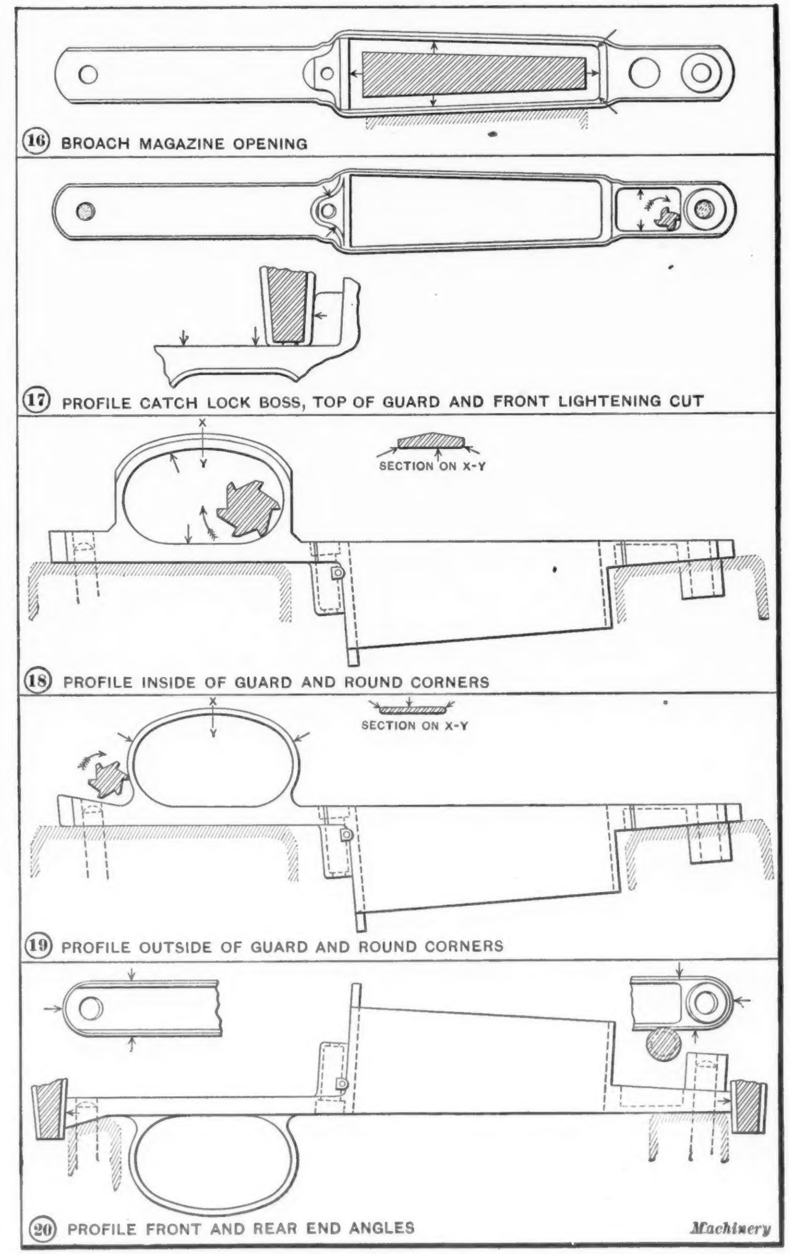


Fig. 51. Operations on Magazine and Trigger Guard (Continued)

Operation 31: Polish.—See "Polish."

Operation 32: Blue.—See "Blue—Gas Furnace Process."

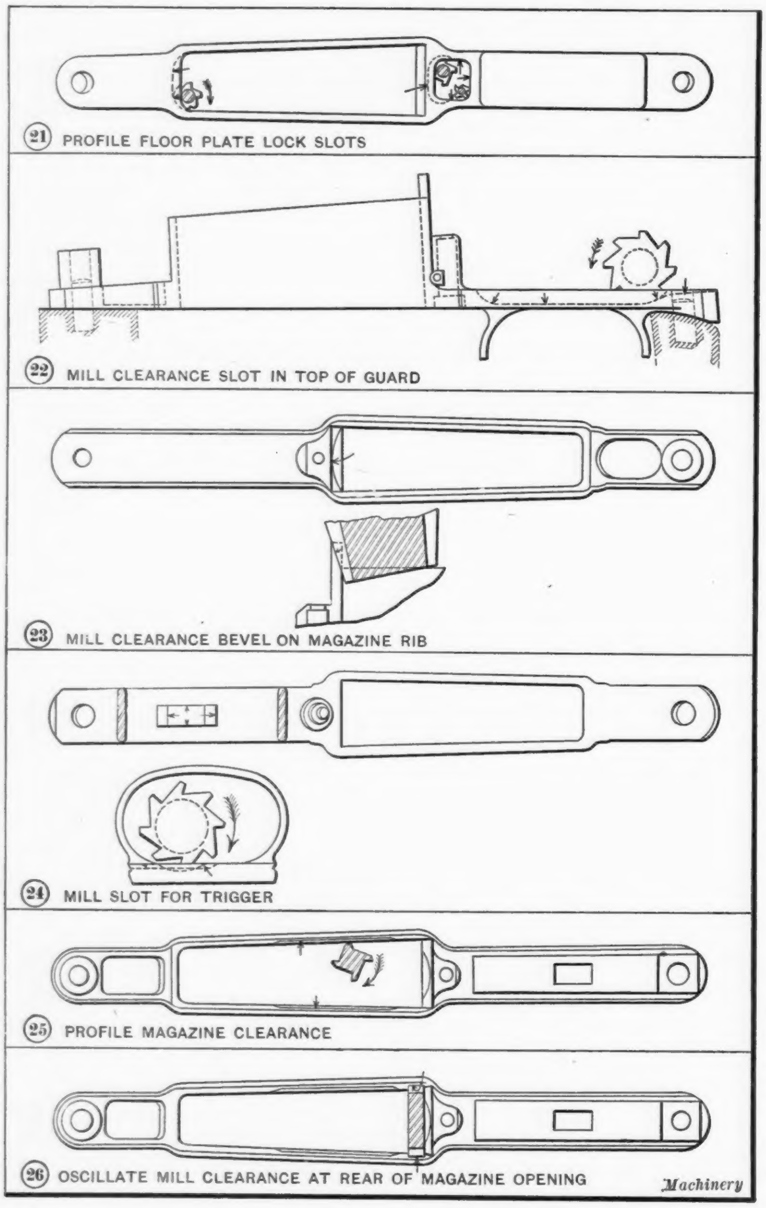


Fig. 52. Operations on Magazine and Trigger Guard (Continued)

OPERATIONS ON MAGAZINE FLOOR-PLATE

The magazine floor-plate (see Fig. 47) is drop-forged from a 5/16 by 1 1/8 inch rectangular bar of gun steel and trimmed, after which it is annealed and pickled. The bottom surface and ends are next milled on a Lincoln type milling machine having a fixture that holds two pieces, after which a cut is taken across the top to remove most of the superfluous stock, and at the same time the two edges are milled. For the subsequent gaging and machining operations, the bottom and top surfaces and the ends are used as locating points. For additional details, such as feeds, speeds and production, see Table XXV.

Operation 1: Drop-forge and Trim.—This operation is done on an 800-pound drop-hammer. One man attends to the furnace, trimming press and drop-hammer.

Operation 2: Anneal and Pickle.—See "Anneal" and "Pickle."

Operation 3: Mill Bottom Surface and Ends, Rough.—This is accomplished on a Lincoln type milling machine, using special vise jaws in which two pieces are held. The jaws are formed to the same contour as the piece by milling previous to hardening.

Operation 4: Mill Top Surface, Rough.—This operation is done on a Lincoln type milling machine, using a quick-acting vise that holds two pieces.

Operation 5: Mill Right-hand Edge.—This is done on a Lincoln type milling machine, using a special set of vise jaws that hold six pieces, arranged to be milled lengthwise, and held at the required angle.

Operation 6: Mill Left-hand Edge.—This is similar to Operation 5, except that the vertical location is determined by the previously finished surfaces.

Operation 7: Profile Magazine Spring Clearance, Rough and Finish.—This is performed on a two-spindle profiling machine and consists in cutting out the pocket in which the magazine spring works, the roughing and finishing cuts being made by the two spindles on the machine. A special fixture with suitable formers is used for producing the correct form.

Operation 8: Profile Locating Ledge and Locking Lugs, Rough and Finish.—This operation is accomplished on a two-spindle profiling machine, using a special fixture with formers, as in Operation 7.

Operation 9: Profile Front and Rear Locking Lug Slots, Rough and Finish.—This is done on a two-spindle profiling machine, using a special fixture and formers. A special T-cutter is used for under-cutting.

Operation 10: Profile Magazine Locking Spring T-slot.—This operation is accomplished on a one-spindle profiling machine, using a T-cutter for under-cutting the slot in which the magazine spring is locked.

Operation 11: Mill Bottom, Finish.—This is accomplished on a Lincoln type milling machine, using a special fixture that holds two pieces and eccentrically relieved cutters.

Operation 12: Mill Contour on Lower Front and Rear Ends.—This operation is accomplished on a hand milling machine, using a special fixture having a forming plate by which the movement of the spindle is controlled.

Operation 13: Drill and Countersink Floor-plate Catch Clearance Hole.—This is done on a two-spindle drilling machine, using a drill jig in which the piece is located from the locating ledge and the finished surface, and which is so arranged that the drilling is done from one side of the jig through a bushing, while the opposite side is left open so that a countersink can be used.

Operation 14: Profile Entire Edge Outline.—This is accomplished on a one-spindle profiling machine, using a special fixture and forming plate, so that the piece will conform in its outline to the portion of the magazine and trigger guard which it fits.

Operation 15: Stamp.—This is a hand operation.

Operation 16: Polish.—See "Polish."

Operation 17: Blue.—See "Blue—Niter Process."

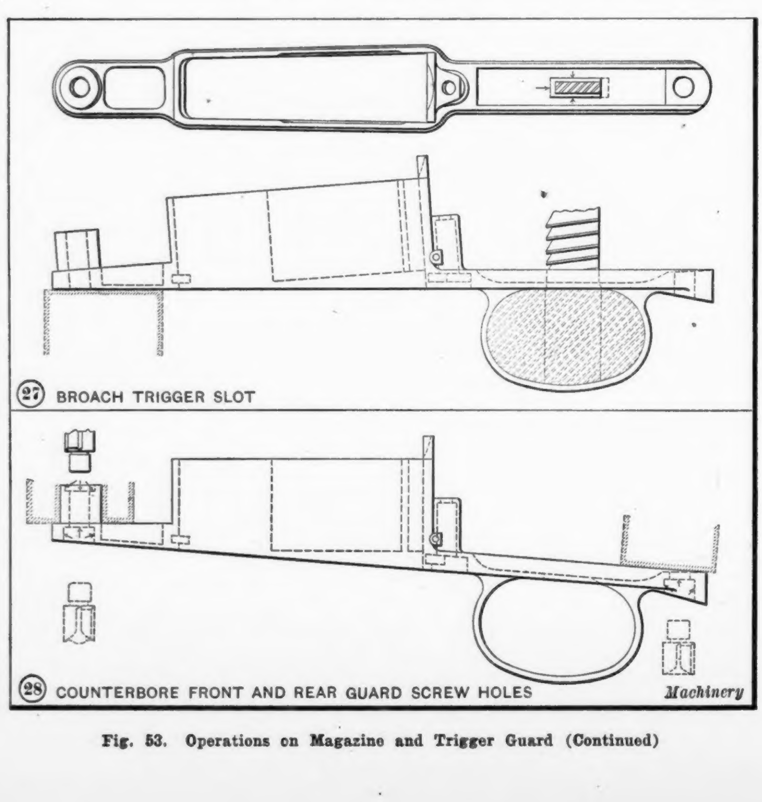


Fig. 53. Operations on Magazine and Trigger Guard (Continued)

OPERATIONS ON MAGAZINE PLATFORM

The magazine platform (see Fig. 47) is drop-forged from a 3/4 by 5/16 inch rectangular hot-drawn bar of gun steel. After forging, trimming, annealing and pickling, the bottom and ends are rough-milled on a Lincoln type milling machine, using a special fixture that holds two pieces. This roughly milled surface acts as a locating point for the subsequent roughing operations which are: rough-milling the top and partition and milling the right- and left-hand edges. These operations remove the surplus stock from the forging and relieve the strains in the metal. The bottom and ends are then finish-milled, and these surfaces are used for locating.

Operation 1: Drop-forge and Trim.—This operation is accomplished on an 800-pound drop-hammer, using forging dies; the trimming is done on a trimming press.

Operation 2: Anneal and Pickle.—See "Anneal" and "Pickle."

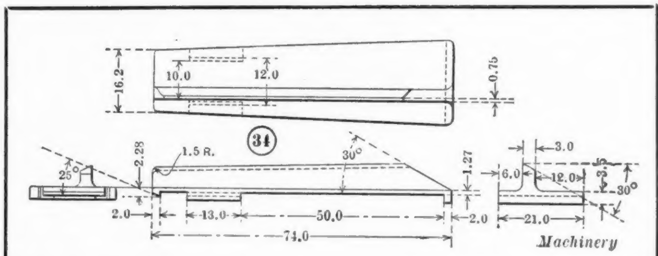
Operation 3: Mill Bottom and Ends, Rough.—This operation is accomplished on a Lincoln type milling machine, using a special fixture that holds two pieces, and interlocking cutters to preserve the shoulder distances.

Operation 4: Mill Top and Partition, Rough.—This is done on a Lincoln type milling machine, in a special fixture that holds two pieces which are located by the bottom surface and ends previously milled.

Operation 5: Mill Right-hand Edge.—This operation is accomplished on a Lincoln type milling machine, using a special fixture that holds two pieces and is so arranged that the pieces lie with their upper edges in a horizontal plane. The pieces are clamped against the previously milled bottom surface and rest with their lower edges on pins.

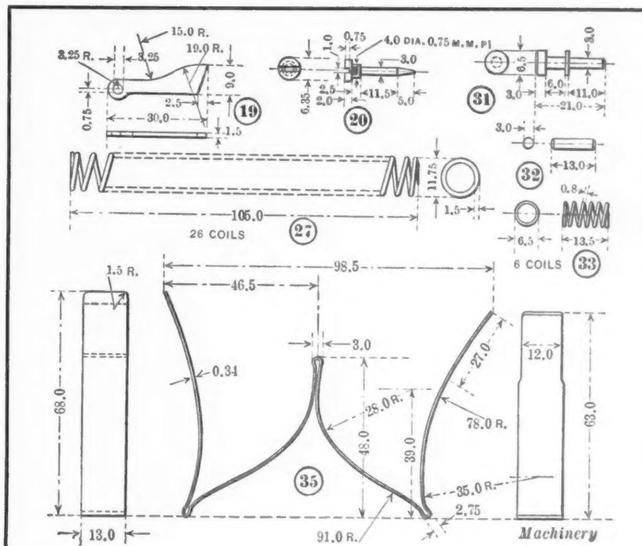
Operation 6: Mill Left-hand Edge.—This is similar to Operation 5, except that the finished edge rests on the pins.

TABLE XXVI. OPERATIONS ON MAGAZINE PLATFORM—PART NO. 34



Oper. No.	Operation	Mach. Used	Tool or Fixture	Speed, Surface Feet per Min.	Feed per Rev., Inches	Hourly Product per Mach.	Machs. per Operator
1	Drop-forge and trim	800-pound drop-hammer	Forge dies	..	..	50	1
2	Anneal and pickle	Annealing furnace	......	..	..	60	See text
3	Mill bottom and ends, rough	Lincoln type mill. mach.	Spec. fixt. holds two pieces	60	0.032	80	2
4	Mill top and partition, rough	Lincoln type mill. mach.	Spec. fixt. holds two pieces	60	0.032	50	2
5	Mill right-hand edge	Lincoln type mill. mach.	Spec. fixt. holds two pieces	60	0.032	50	2
6	Mill left-hand edge	Lincoln type mill. mach.	Spec. fixt. holds two pieces	60	0.032	50	2
7	Mill bottom and ends, finish	Lincoln type mill. mach.	Spec. fixt. holds two pieces	70	0.020	80	2
8	Mill taper and bevel on partition	Lincoln type mill. mach.	Spec. fixt. holds two pieces	70	0.020	50	2
9	Mill bevel on rear end of partition	Hand mill. mach.	Spec. angular fixt.	70	Hand	80	1
10	Mill clearance slot for magazine spring	Hand mill. mach.	Spec. fixt.	60	Hand	60	1
11	Mill locking T-slots for magazine spring	Hand mill. mach.	Spec. fixt.	60	Hand	50	1
12	Mill bevel on lower front end	Hand mill. mach.	Spec. fixt.	70	Hand	80	1
13	Stamp	Bench work	Bench work	..	..	250	1
14	File corners and burr	Bench work	Files	..	..	50	1
15	Caseharden	Cyanide furnace	......	..	..	75	1
16	Polish	Polishing lathe	Leather cov. wheels	5000	..	40	1
17	Blue	Niter bath	......	..	..	See text	

TABLE XXVII. OPERATIONS ON MISCELLANEOUS PARTS



Part. No.	Operation	Mach. Used	Hourly Product per Mach.	Machs. per Operator
19	Pierce and blank	No. 5 punch press	1500	1
19	Harden and temper	Hard. furn. Temper. bath	200	1
20	Turn, form, thread, cut off and slot	Auto. screw mach. with slotting attach.	200	3
20	Harden and temper	Hard. furn. Temper. bath	200	1
27	Wind, set and cut off	No. 1 spring coiling mach.	3000	4
27	Grind ends	Disk grinder, cup wheel	100	1
27	Spring temper	Temper. bath	200	1
31	Turn, form, cut off and burr	Auto. forming mach. with burring attach.	300	3
31	Caseharden	Cyanide furnace	250	2
32	Cut off and burr	Auto. forming mach. with burring attach.	1000	2
32	Harden and temper	Hard. furn. Temper. bath	250	2
33	Wind, set and cut off	No. 1 spring coiling mach.	5000	4
33	Grind ends	Disk grinder, cup wheel	200	1
33	Spring temper	Temper. bath	200	1
35	Blank and trim	No. 5 punch press	1800	1
35	First bend	No. 5 punch press	360	1
35	Second bend	No. 5 punch press	360	1
35	Set bends	Bench fixture	240	1
35	Harden	Hard. furnace and fixt.	20	1
35	Temper	Temper. bath	100	1
35	Compress	Special fixture	60	1
35	Test compress	Special fixture	20	See text

Operation 7: Mill Bottom and Ends, Finish.—This operation is accomplished on a Lincoln type milling machine, using a special fixture that holds two pieces, these being located on the finished top to give the vertical position, and against a swinging stop to give end location. This stop is arranged so that it can be swung out of the way while milling.

Operation 8: Mill Taper and Bevel on Partition.—This is performed on a Lincoln type milling machine, using a special fixture that holds two pieces. These pieces are so located that the upper surface of the partition lies in a horizontal plane. The cutters are angular so as to produce the desired form.

Operation 9: Mill Bevel on Rear End of Partition.—This is done on a hand milling machine, using a special fixture.

Operation 10: Mill Clearance Slot for Magazine Spring.—This operation is done on a hand milling machine, using a special fixture that holds one piece. An end-mill is used.

Operation 11: Mill Locking T-slots for Magazine Spring.—This is also accomplished on a hand milling machine, using a special fixture that holds one piece. A T-cutter cuts the slot on one side, and the spindle is then dropped sufficiently to bring it into the correct position for cutting the other slot. Suitable stops are provided to give the correct distance.

Operation 12: Mill Bevel on Lower Front End.—This operation is accomplished on a hand milling machine, using a special fixture that holds one piece.

Operation 13: Stamp.—This is a hand operation.

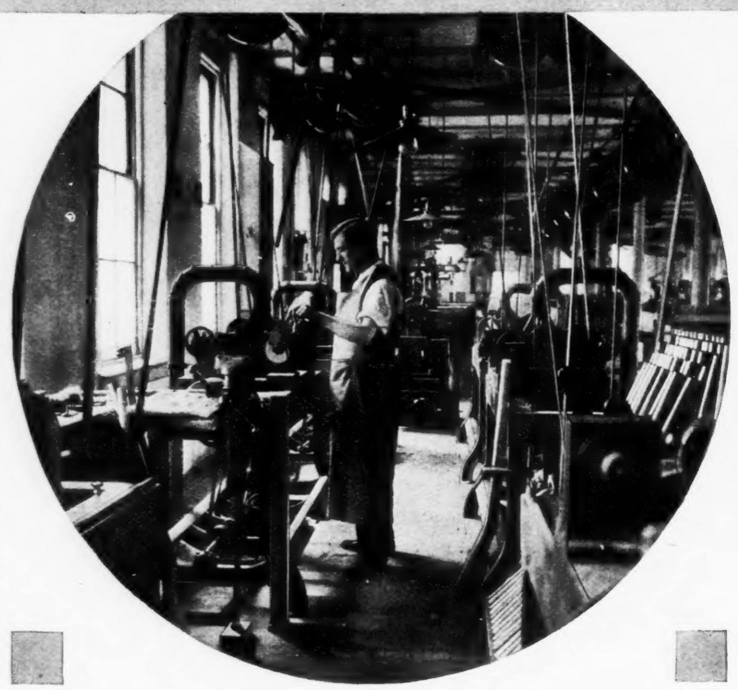
Operation 14: File Corners and Burr.—This consists in removing the burrs and rounding the corners by hand.

Operation 15: Caseharden.—See "Caseharden."

Operation 16: Polish.—See "Polish."

Operation 17: Blue.—See "Blue—Niter Process."

Machining Gun Stocks



To machine a military rifle stock successfully is no easy proposition, as has been proved by many of the manufacturers who have gone into this business since the outbreak of the present war. Prior to the year 1822, rifle stocks were made by hand and, of course, were much cruder than they are at the present day, when highly developed machines are used. The output was one stock in ten hours. In 1822, Thomas Blanchard, then employed at the Springfield Armory, Springfield, Mass., invented a special gun-stock turning lathe which was subsequently known as the Blanchard lathe. This lathe revolutionized the method of making rifle stocks, and while the construction has been improved to a considerable extent, the original design remains practically the same. The original lathe, designed and built by Thomas Blanchard, is shown in Fig. 55. Here it will be noticed that the main structure of the machine is made from heavy timber, bolted together, and with the exception of the gears, center frame and copying wheel, most of the parts are made from wood. A metal copying pattern was used, which controlled the frame carrying the revolving stock to be turned. The movement of this frame was controlled by a wheel running on the metal pattern which, as will be seen, is rotated. The copying wheel is held on the frame to which the cutter-head is attached. It is evident, therefore, that as the gun stock rotates, the cutter-head is moved in and out according to the shape of the pattern, and consequently produces a similar form on the wood stock. The cutters are of the scoop type, and are held to the rotating cutter wheel.

At the outbreak of the present war, practically none of the rifle manufacturers were in a position to turn out a military rifle stock to meet the specifications and requirements of the foreign governments. At first glance, it appeared to be a comparatively simple proposition, but when it was considered that rifle stocks must be turned out in large numbers and must be absolutely interchangeable with as little hand work as possible, the difficulty of the task was realized. The Defiance Machine Co. of Defiance, Ohio, entered this line of manufacture early and undertook to design and build special machinery for handling rifle stocks so as to eliminate practically all hand operations. The result has been that a complete line of rifle machinery has been designed and built which will turn out military rifle stocks on an interchangeable basis at a speed giving a production in the neighborhood of one and one-quarter man-hour for the stock and about one-quarter man-hour for the hand guard. The operations which follow cover the manufacture of the stock and give an idea of the difficult nature of the work.

OPERATIONS ON STOCK

The stock (see Fig. 54) and hand guard (Fig. 66) are made from various grades of wood, walnut being most generally used. This has to be seasoned for approximately three years and is received by the rifle plant in the rough sawn condition. It is again seasoned and the first machining operation is to joint one side so as to take out any twist. It is then planed on the opposite side to straighten it and bring it to approximately the required thickness. The stock is then rough-turned, after which it is grooved for the barrel and inletted for the receiver. The barrel groove and top edge, after being machined, act as locating points for the subsequent machining and gaging operations. For speeds, feeds and production, see Table XXVIII.

Operation 1: Joint One Side.—This is accomplished on a 16-inch hand feed planing and jointing machine, in which a three-knife cutter-head is used. The number of cuts required to take out the twist in the stock depends, of course, upon its condition.

Operation 2: Plane Other Side to Thickness.—This operation is accomplished on a 26-inch four-roll surface planer which is capable of handling four stocks at one time. This machine also uses a three-knife cutter-head and has a power roll feed.

Operation 3: Trim Both Ends.—This is done by a single-head trimming or equalizing saw. The table of the machine is provided with gages for gaging the cuts on both ends of the stock.

Operation 4: Joint Top Edge.—This is accomplished on a facing saw. The stock is clamped to a metal pattern which is placed on the table of the sawing machine and is then moved past the trimming saw.

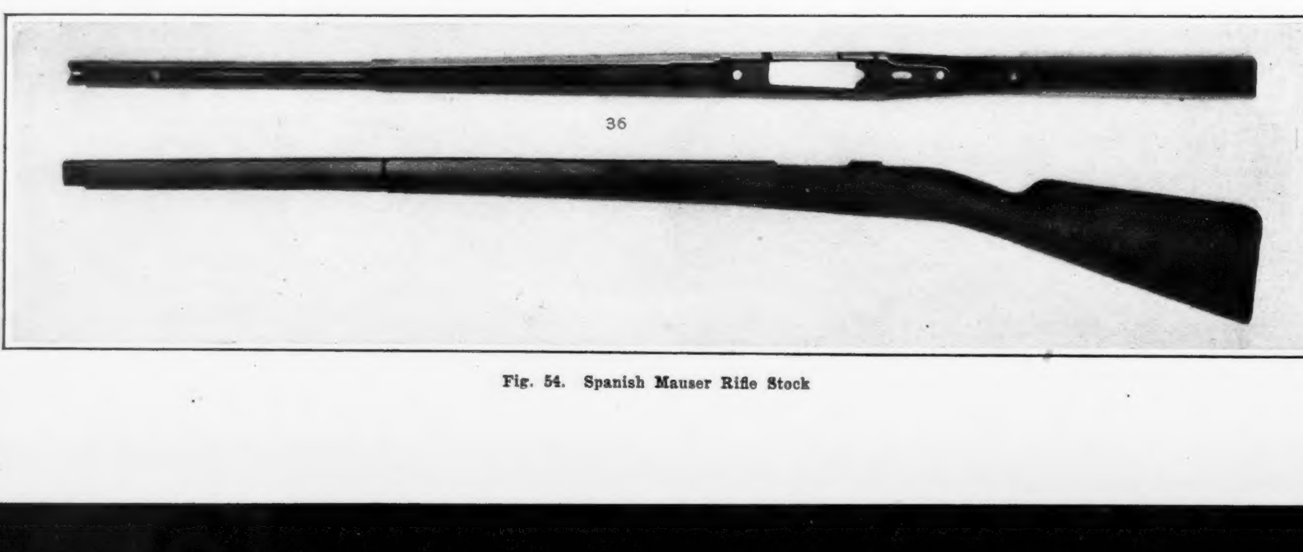


Fig. 54. Spanish Mauser Rifle Stock

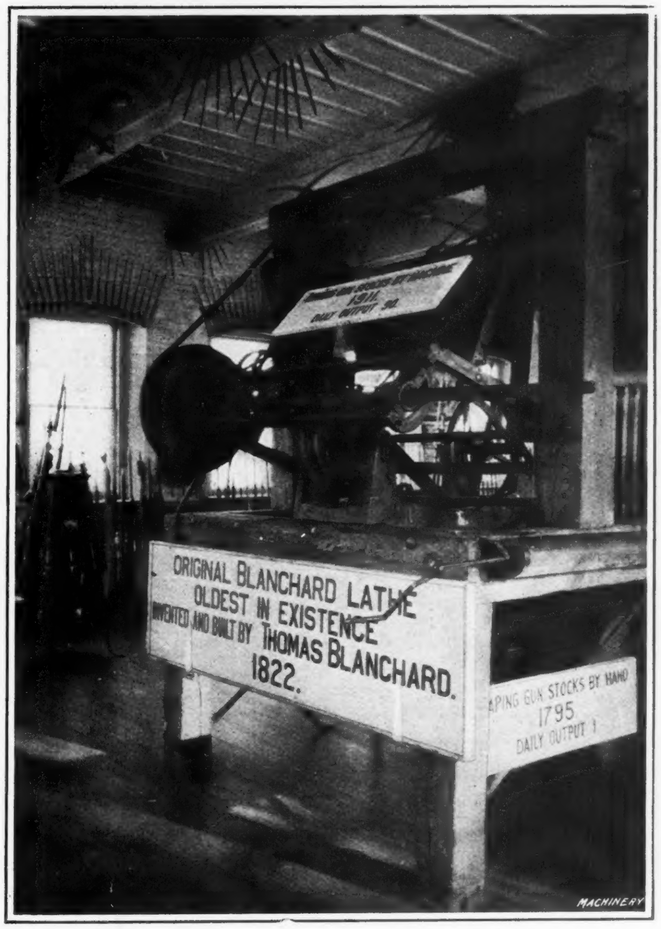


Fig. 55. Original Blanchard Lathe designed and built in the Springfield Armory in 1822 by Thomas Blanchard

Operation 5: Lay out to Pattern.—This is a hand operation and consists in scribing around the pattern, leaving sufficient stock for turning.

Operation 6: Band-saw to Shape.—This operation is accomplished by a 36-inch band sawing machine, using a saw ½ inch wide. The stock is roughed out to the previously outlined pattern marks.

Operation 7: Bore Driving Holes in Butt End.—This is accomplished on a two-spindle horizontal boring machine. The stock is located from the previously jointed top surface and ordinary boring bits are used.

Operation 8: Inspect.—This is done to see if the stock has any shakes or defects after a cut has been taken all around.

Operation 9: Turn Butt End, Rough.—This operation is performed on a gun stock copying lathe. The stock is driven from the butt end by means of two driving pins and held by the muzzle end in a clamping fixture. The cutters are of the scoop type, twelve being fastened to a revolving head. This cut extends to a point slightly beyond the lower band groove.

Operation 10: Turn Fore End, Rough.—This is accomplished on a special gun stock fore end turning lathe. The stock is held in the same manner as for the previous operation, and the turning is done with a series of cutters which are clamped to a revolving cutter-head. The cutters are about 2 inches wide, and the cuts extend slightly beyond the previous roughing cut on the butt end.

Operation 11 Spot One Side for Bearing Points.—This is done on a special spotting machine which has a special clamping fixture, the stock being located from the previously finished top surface. The table moves up and down past a series of cutters which are about 1¼ inch wide, and are of the circular solid blade type.

Operation 12: Rout and Bed Barrel Groove, and Rough Inlet for Receiver.—This operation is performed on a six-spindle barrel inletting and bedding machine. The first series of operations consists in routing out the barrel groove with an expanding routing cutter controlled by taper guides. This makes the groove in the barrel tapered, and leaves as little stock as possible to be removed by the finish bedding cutters. The next operation consists in roughing out the impressions for the receiver, which is accomplished by means of routing cutters controlled by templets or guides. After the outline for the receiver has been rough-routed, the barrel bedding is finished by bringing down a long bar extending the full length of the stock and carrying a series of blade cutters overlapping each other and located spirally. This is fed directly down into the groove of the stock, and finishes the different shoulders to the required length and radius. For this operation the stock is held by being clamped up against the top surface and the five previously finished bearing points.

Operation 13: Inspect.—This is necessary to see that every operation has been properly conducted up to this point.

Operation 14: Inlet for Receiver and Lightening Cuts.—This operation is accomplished on a five-spindle inletting machine, using the same type of cutters as for the previous inletting

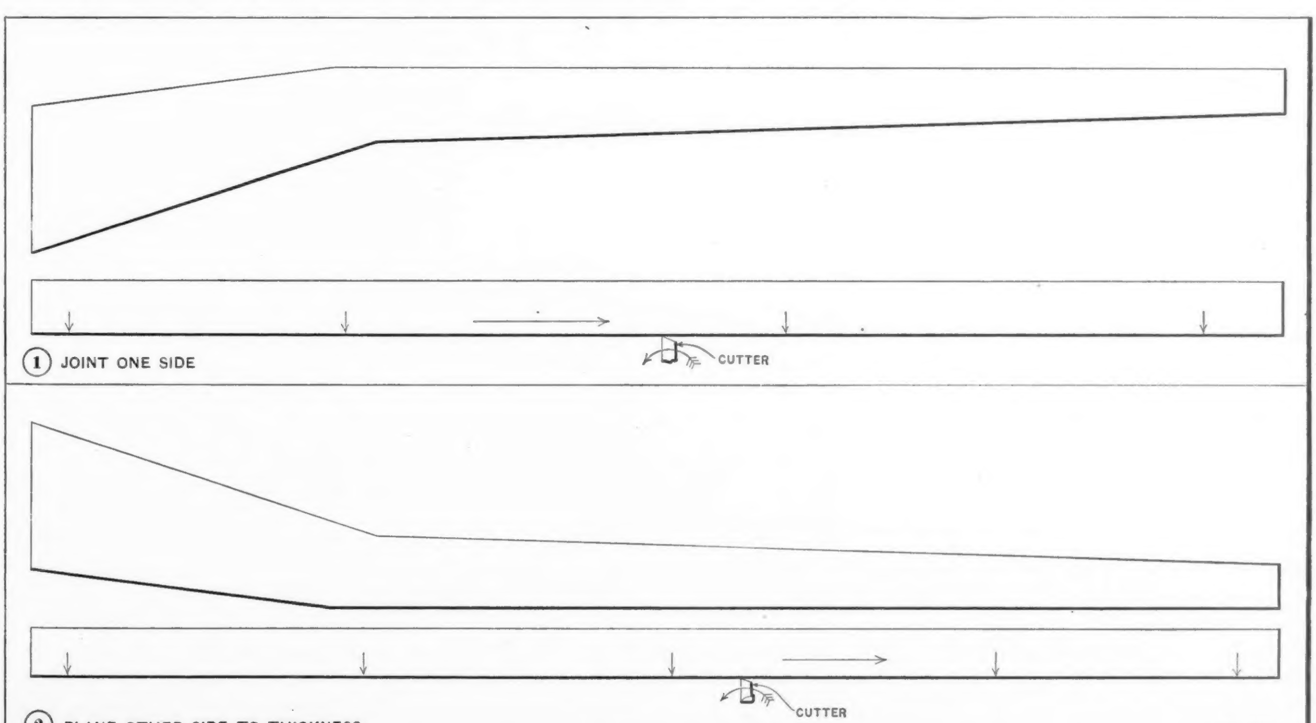
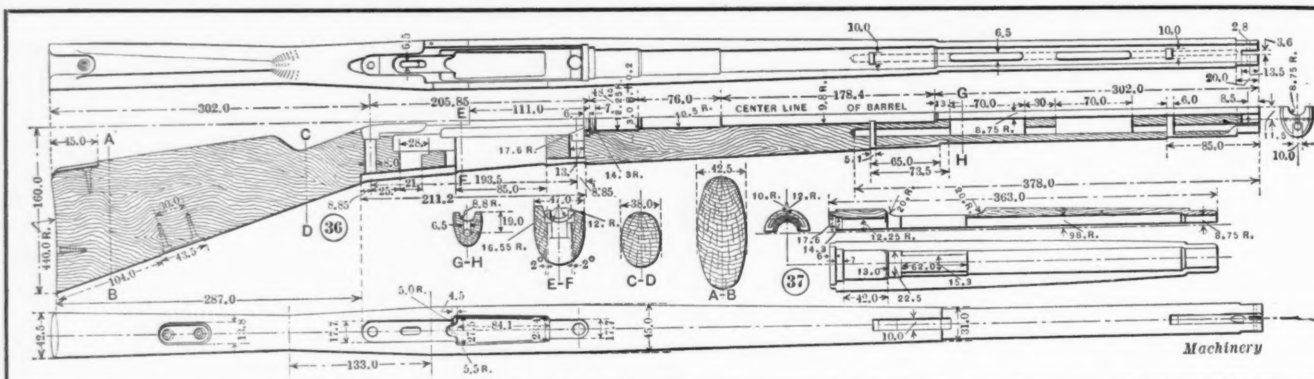


Fig. 56. Operations on Spanish Mauser Rifle Stock

TABLE XXVIII. OPERATIONS ON STOCK AND HAND GUARD



Oper. No.	Operation	Mach. Used	Tool or Fixture	Speed, Surface Feet per Min.	Feed, Feet per Min.	Hourly Product per Mach.	Machs. per Operator
1	Joint one side	16-inch planing and jointing mach.	Three-blade cutter-head	6500	Hand	100	1
2	Plane other side to thickness	26-inch four-roll surface planer	Three-blade cutter-head	6500	50	800	2 men
3	Trim both ends	Trimming saw	Gages Roller table Cut-off saw	9000	Hand	100	1
4	Joint top edge	Facing saw	Roller table Clamp. fixt.	9000	Hand	100	1
5	Lay out to pattern	Bench work	Templet	..	..	200	1
6	Band-saw to shape	36-inch band saw. mach.	1/2-inch band saw	4500	Hand	100	1
7	Bore driving holes in butt end	Two-spindle horiz. boring mach.	Clamp. fixt. Wood bit	2000	Hand	200	1
8	Inspect	Bench work	Gages	..	..	50	1
9	Turn butt end, rough	Gun stock copying lathe	12-knife cutter-head	7000	3/4	12	3
10	Turn fore end, rough	Semi-auto. gun stock lathe	Spec. cutter-head	6500	Hand	55	2
11	Spot one side for bearing points	Spec. spotting mach.	Clamp and movable table	960	Hand	135	1
12	Rout and bed barrel groove and rough inlet for receiver	Six-spindle inletting and barrel bedding mach.	Clamp. fixt. Forms and special cutter-bar	400-1800	Hand	8	1
13	Inspect	Bench work	......	..	..	25	1
14	Inlet for receiver and lightening cuts	Five-spindle inletting mach.	Clamp. fixt. Forms and spec. cutter	400-600	Hand	25	1
15	Center sides with barrel groove	Two-spindle vertical shaping mach.	Spec. clamp. fixt.	5000	Hand	100	1
16	Face top to barrel center line	Two-spindle vertical shaper	Spec. clamp. fixt.	5000	Hand	100	1
17	Shape top and lower edges of butt	Two-spindle vertical shaper	Spec. clamp. fixt.	5000	Hand	100	1
18	Trim butt and fore end and profile butt	Comb. vertical profiler and trim. saw	Spec. clamp. fixt.	5000-9000	Hand	90	1
19	Inlet for butt plate tang and drill butt plate holes	Inlet. and drill. mach., four spindles	Spec. clamp. fixt.	400-600	Hand	100	1
20	Inlet and drill for butt sling swivel block	Three-spindle inlet. mach.	Spec. clamp. fixt.	400-600	Hand	120	1
21	Inlet for magazine and trigger guard	Five-spindle inlet. mach.	Spec. clamp. fixt.	400-600	Hand	40	1
22	Inspect	Bench work	Gages	..	..	25	1
23	Turn butt end, finish	Gun stock copying lathe	Twelve-blade cutter-head	7000	3/8	6	4
24	Turn for band seats	Semi-auto. gun stock lathe	Spec. cutter-head	6500	Hand	50	1
25	Turn in between bands	Semi-auto. gun stock lathe	Spec. cutter-head	6500	Hand	50	1
26	Profile bolt, retaining bolt and cartridge clearance cuts	Three-spindle profiling mach.	Profiling cutters	400-600	Hand	50	1
27	Bore cleaning rod hole	One-spindle horiz. boring mach.	Spec. bush. Clamp. fixt.	140	Hand	50	1
28	Drill upper band nose plate pin hole	Two-spindle horiz. drill. mach.	Spec. fixt.	70	Hand	200	1
29	Inlet for band spring catch seats	Three-spindle inlet. mach.	Spec. fixt. and guide	400-600	Hand	35	1
30	Slot for tang on upper band nose plate	Grooving mach.	Spec. fixt. Slitting saw	9000	Hand	240	1
31	Square band spring catch slots	Mortising mach.	Spec. fixt. Mort. cutter	50 st'k's	Hand	40	1
32	Shape around sides of butt end	Spec. shap. mach.	Spec. fixt. Three-blade cutter-head	6500	Hand	50	1
33	Finish-shape sides of stock	Two-spindle vertical shaping mach.	Spec. fixt. Three-blade cutter-head	6500	Hand	100	1
34	Square corners in receiver opening	Bench work	Hand tools	..	..	25	1
35	Hand scrape	Bench work	Wood shave	..	..	25	1
36	Hand sandpaper	Bench work	No. 0 sandpaper	..	..	25	1
37	Polish	Polishing lathe	Cotton wheel	5500	Hand	25	1
38	Oil	Dipping tanks	......	..	..	25	1
39	Wipe	......	Waste	..	..	150	1
40	Inspect	......	Gages	..	..	25	1

OPERATIONS ON HAND GUARD

Oper. No.	Operation	Mach. Used	Tool or Fixture	Speed, Surface Feet per Min.	Feed, Feet per Min.	Hourly Product per Mach.	Machs. per Operator
1	Plane one side of block	16-inch hand-fed jointer	Three-blade cutter-head	6500	Hand	1400	1
2	Rip to seven taper blanks	Slide-table saw	Spec. hollow-ground saw	9000	Hand	175	1
3	Saw to turning length	Double-ended equalizing saw	Cut-off saws	9000	Hand	240	1
4	Rout and bed barrel groove	Barrel routing and bedding mach.	Spec. clamp. fixt.	400-1800	Hand	50	1
5	Face to center line of barrel groove	Two-spindle vertical shaper	Three-blade cutter-head	6500	Hand	100	1
6	Turn outside diameter—two at a time	Semi-auto. gun stock lathe	Spec. cutter-head	6500	Hand	120	1
7	Cut off stubs to length	Double-ended equalizing saw	Spec. fixt.	9000	Hand	180	1
8	Gaine sight slide clearance flat	Gaining mach.	Spec. fixt. Cutter-head	6500	Hand	100	1
9	Groove sighting clearance	Gaining mach.	Spec. cutter-head	400	Hand	100	1
10	Inlet for sight base	Three-spindle inlet. mach.	Spec. fixt.	400-600	Hand	50	1
11	Square out corners for sight base	Bench work	Hand tools	..	..	20	1
12	Gaine stock mortise band clearance	Gaining mach.	Spec. fixt. Spec. cutter-head	400	Hand	100	1
13	Hand sandpaper	Bench work	No. 0 sandpaper	..	..	45	1
14	Polish	Polish. lathe	Cotton wheel	5500	Hand	40	1
15	Oil	Dipping tanks	......	..	..	25	1
16	Wipe	......	Waste	..	..	250	1
17	Inspect	......	Gages	..	..	50	1

operation. In this case the inletting for the receiver is finished and the lightening cuts at the fore end of the stock are also produced.

Operation 15: Center Sides with Barrel Groove.—This is done on a vertical shaping machine of a special type, the spindles being located close together. The stock is clamped to a special fixture which fits in the barrel groove. This centering operation is necessary to insure the sides being parallel with the barrel groove, as in some of the previous operations the sides were used for locating points. In this operation these locating points are removed from the side of the stock.

Operation 16: Face Top to Barrel Center Line.—This is accomplished on a vertical shaping machine that has one cutter-head. The stock is located from the barrel groove and one of the finished sides.

Operation 17: Shape Top and Lower Edges of Butt.—This

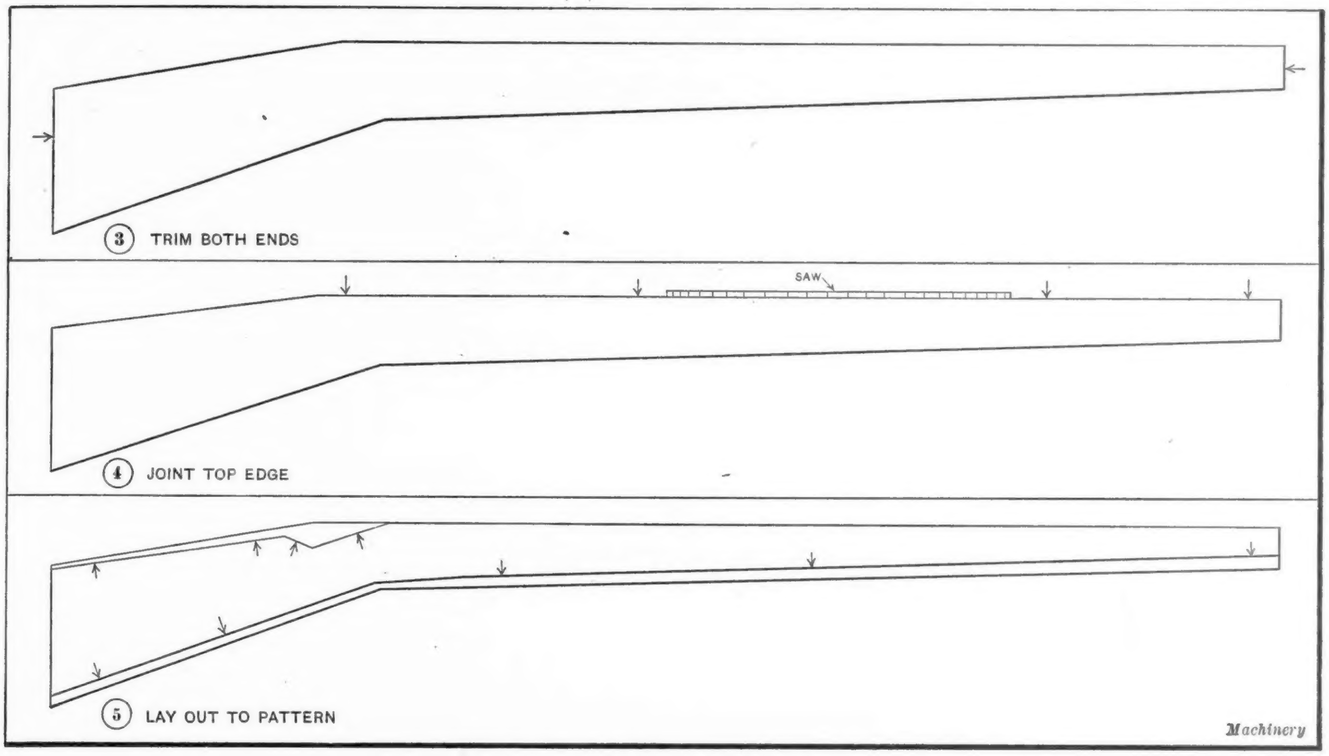


Fig. 57. Operations on Spanish Mauser Rifle Stock (Continued)

operation is performed on a special shaping machine. The stock is clamped in a fixture, and the cut is made on the butt end so as to get the proper drop on the butt portion of the stock for the following operation.

Operation 18: Trim Butt and Fore End and Profile Butt.—This is accomplished on a special combination vertical profiler and trimming saw, using a special fixture in which the stock is clamped from one side and the barrel inlet.

Operation 19: Inlet for Butt Plate Tang and Drill Butt Plate Holes.—This is done on a combination inletting and drilling machine having three inletting spindles and one horizontal drilling spindle. The stock is clamped from one side and the barrel groove, as in the previous operation.

Operation 20: Inlet and Drill for Butt Sling Swivel Block.—This operation is accomplished on a three-spindle inletting machine. The stock is held in the same manner as for Operation 19.

Operation 21: Inlet for Magazine and Trigger Guard.—This is accomplished on a five-spindle inletting machine, using profiling cutters which are controlled by special former plates.

Operation 22: Inspect.—This is necessary to see that the previous operations have been properly conducted before the stock is passed on to the final machining operations.

Operation 23: Turn Butt End, Finish.—This operation is accomplished in a special gun stock copying lathe, using the same type of cutters as in the rough-turning operation. The turning is carried on down to the lower band spring seat.

Operation 24: Turn for Band Seats.—This is accomplished in a semi-automatic gun stock lathe, using a fixture that holds the stock from the barrel groove, and a cutter-head similar to that used for turning the fore end of the stock. Cams control the shape of the cut.

Operation 25: Turn in between Bands.—This is done in a semi-automatic gun stock lathe, using a special cutter-head in which the blades are located in a helical path. In this case the work is turned by one straight-in cut.

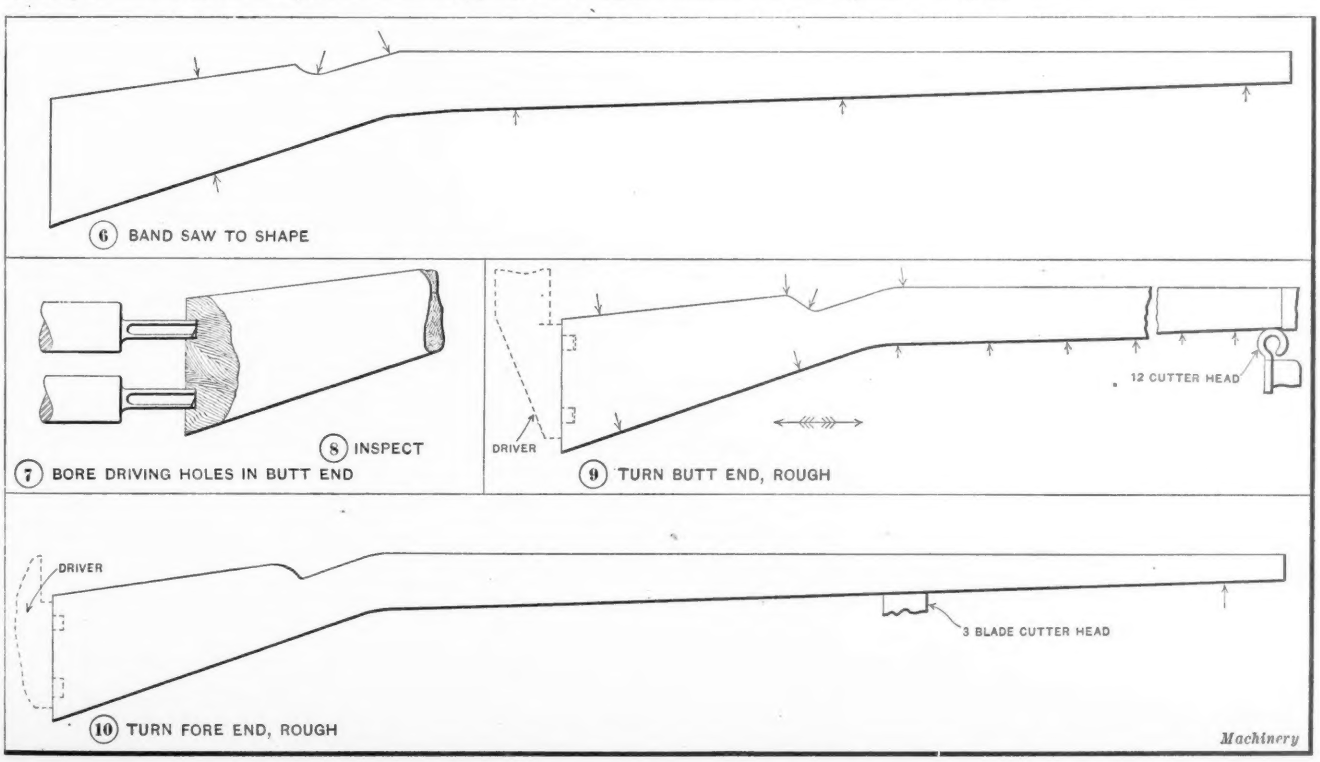


Fig. 58. Operations on Spanish Mauser Rifle Stock (Continued)

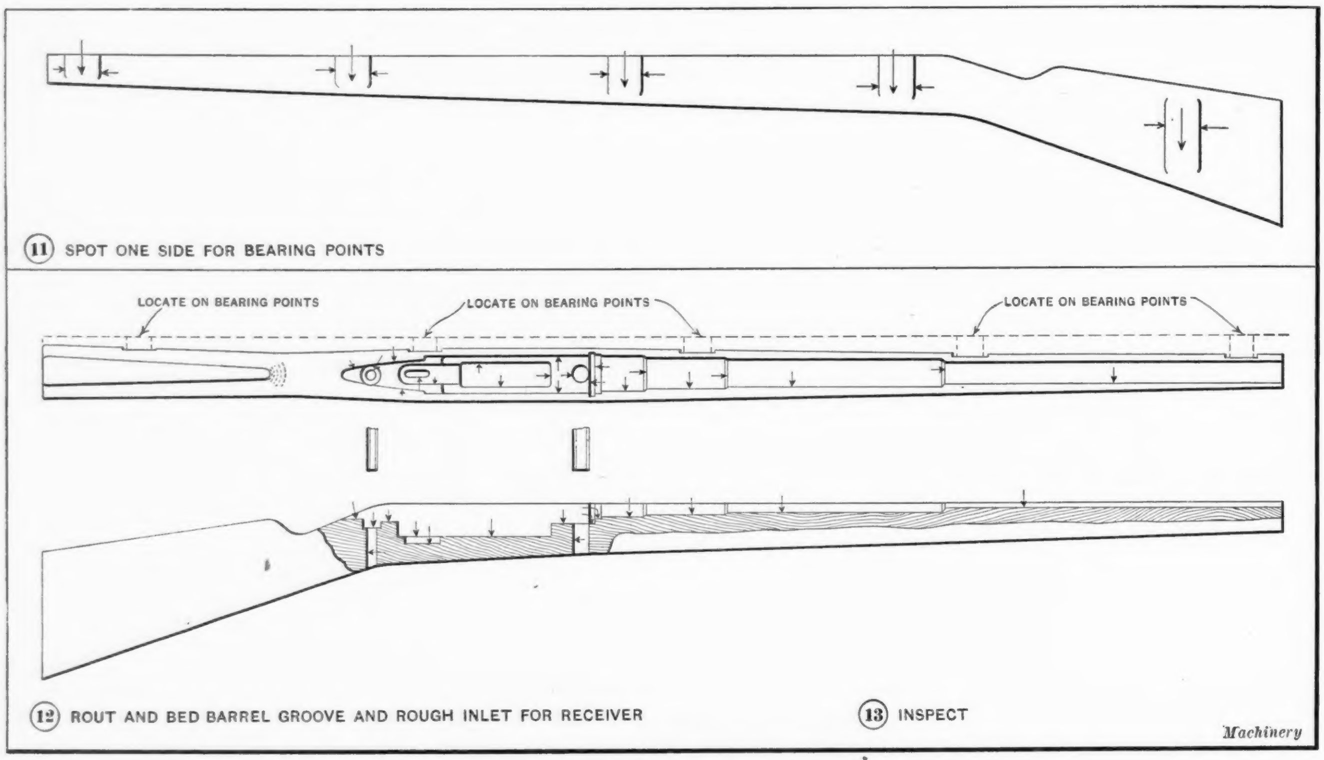


Fig. 59. Operations on Spanish Mauser Rifle Stock (Continued)

Operation 26: Profile Bolt, Retaining Bolt, and Cartridge Clearance Cuts.—This operation is accomplished on a three-spindle profiling machine, using profiling cutters of the regular type and former plates for controlling the movement of the cutters. The stock is located from the barrel groove.

Operation 27: Bore Cleaning Rod Hole.—This is accomplished on a one-spindle horizontal boring machine, using a special fixture for holding the work and an extension boring tool.

Operation 28: Drill Upper Band Nose Plate Pin Hole.—This is done on a two-spindle horizontal drilling machine, the hole being drilled from both sides.

Operation 29: Inlet for Band Spring Catch Seats.—This operation is performed on a three-spindle inletting machine, using regular profiling cutters controlled by former plates.

Operation 30: Slot for Tang on Upper Band Nose Plate.—This is accomplished on a special grooving machine, using a grooving cutter. The table is moved up past the cutter.

Operation 31: Square Band Spring Catch Slots.—This is done on a vertical mortising machine, using a hollow chisel and clamping the work in a special fixture.

Operation 32: Shape Around Sides of Butt End.—This operation is accomplished on a special horizontal shaping machine. The stock is held to a special former fitting in the butt plate profiled outline. At the same time, a roller on the cutter-bar operates on the opposite end of the stock near the point which is reduced for the "pistol grip." The stock is then rotated around on top of the cutter-head by hand, and finished off in this manner, removing all the previous spiral tool marks.

Operation 33: Finish-shape Sides of Stock.—This operation is accomplished on a two-spindle vertical shaping machine, using cutters of the form type. The stock is clamped to a special fixture and located from the top face and barrel groove. This fixture carries a pattern that controls the shape of the stock, or its position relative to the cutter-head.

Operation 34: Square Corners in Receiver Opening.—This is

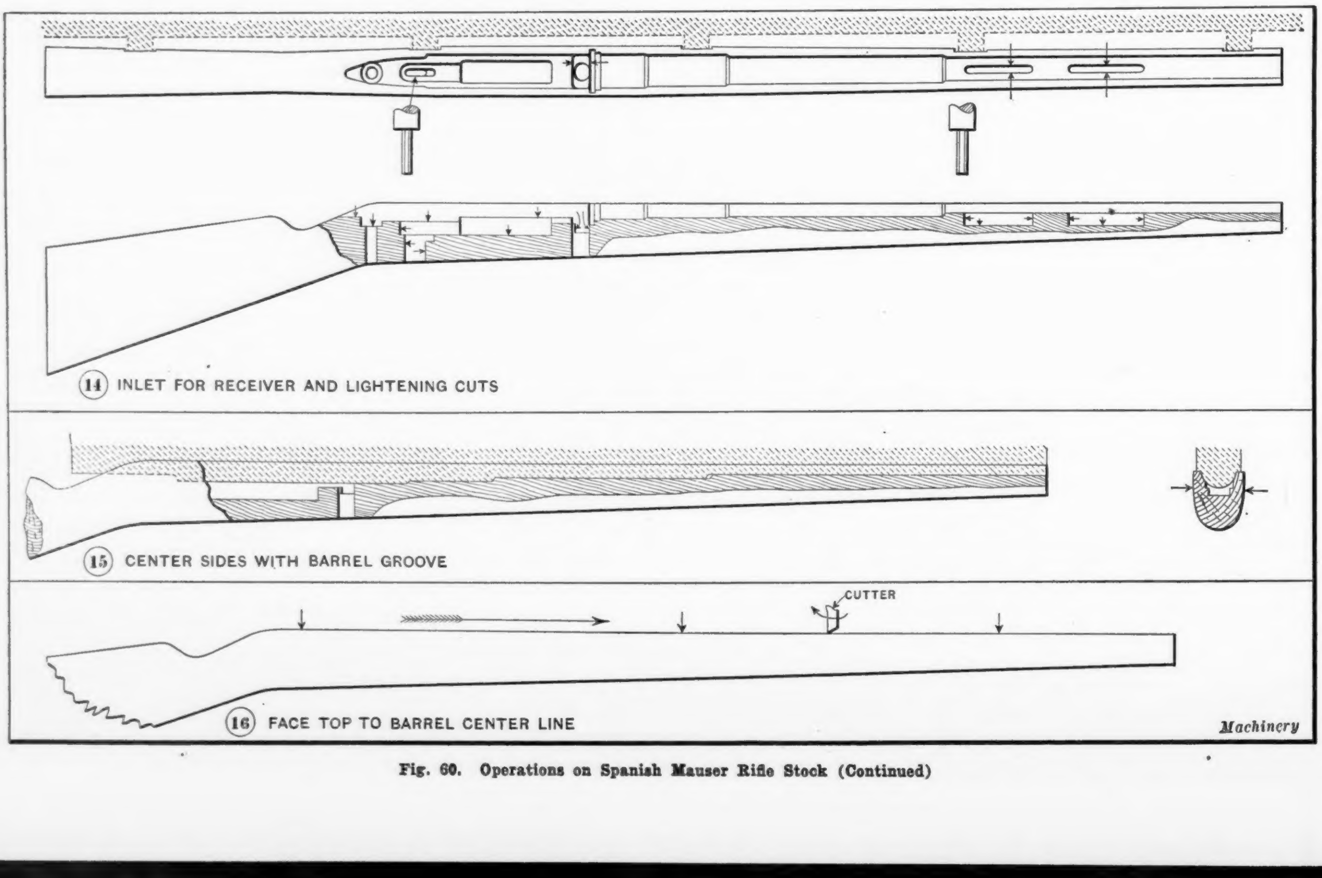


Fig. 60. Operations on Spanish Mauser Rifle Stock (Continued)

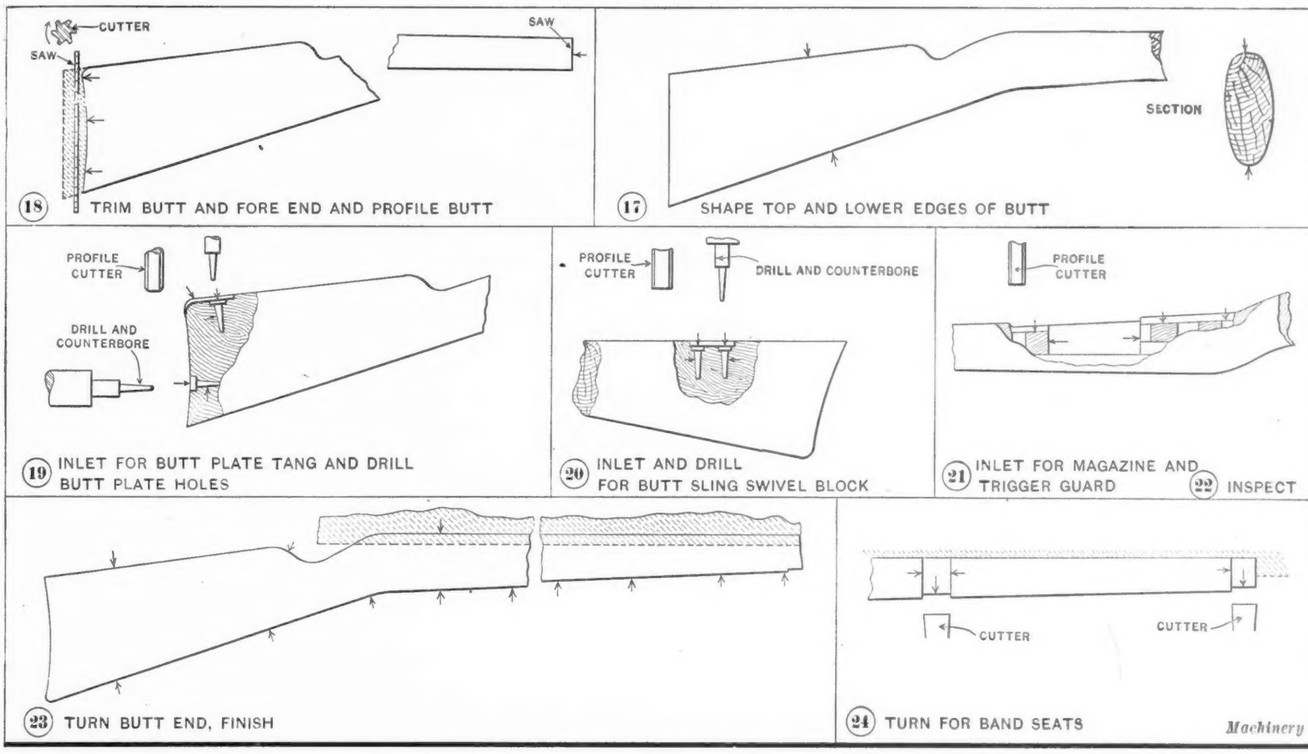


Fig. 61. Operations on Spanish Mauser Rifle Stock (Continued)

a bench operation and consists in using hand tools for squaring out the corners previously left round by the inletting operation.

Operation 35: Hand Scrape.—This is also a bench operation, consisting in using a wood shave for finishing the stock at those points where the cutter-heads have left feed marks. The stock is scraped down slightly below the depth of the feed marks.

Operation 36: Hand Sandpaper.—This is also a bench operation, and consists in sandpapering the stock, ready for polishing.

Operation 37: Polish.—This is accomplished by a cotton wheel rotated at a speed of about 5500 surface feet per minute. The surface of the wheel is generally left plain for finishing rifle stocks, because a high polish is not desired.

Operation 38: Oil.—This consists in dipping the stock in linseed oil and allowing the oil to penetrate about 1/16 inch.

Operation 39: Wipe.—This consists in drying off all the superfluous oil and cleaning the stock with cotton waste.

Operation 40: Inspect.—This is the final inspection and consists in going over all parts of the stock to see that it is up to the required dimensions and has no imperfections.

OPERATIONS ON HAND GUARD

The hand guard is made from the same material as the stock, and it is often made from stocks which have imperfections that prevent them from passing inspection; in such cases, the stock is cut up into strips and used for the hand guard, the imperfect portions being thrown away. When this plan is followed, the preliminary operations vary somewhat from those followed when the hand guard is made from blocks of the required size. In order to make the following description clear, we will start with a block of stock of a sufficient length and width to make seven hand guards. The operations on this part are somewhat

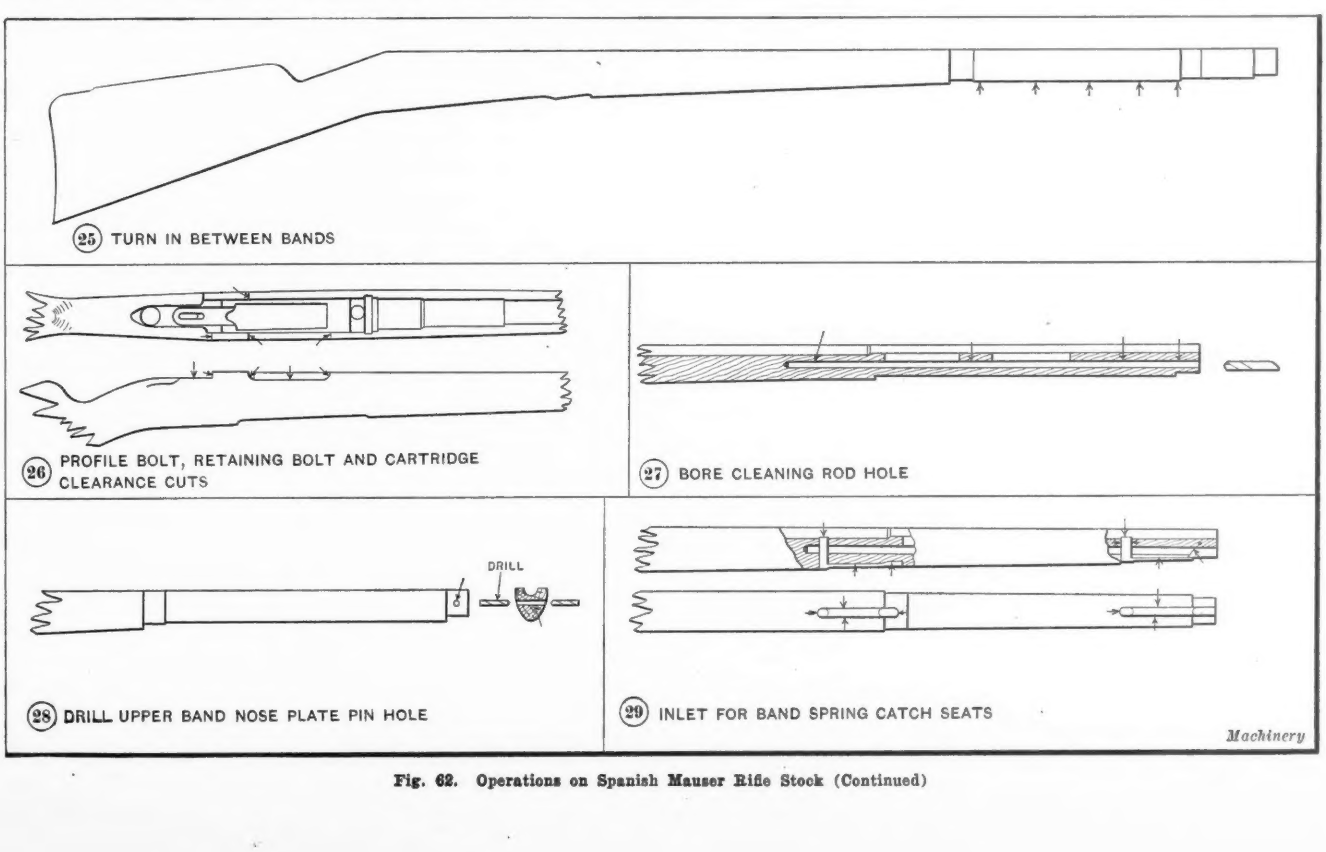


Fig. 62. Operations on Spanish Mauser Rifle Stock (Continued)

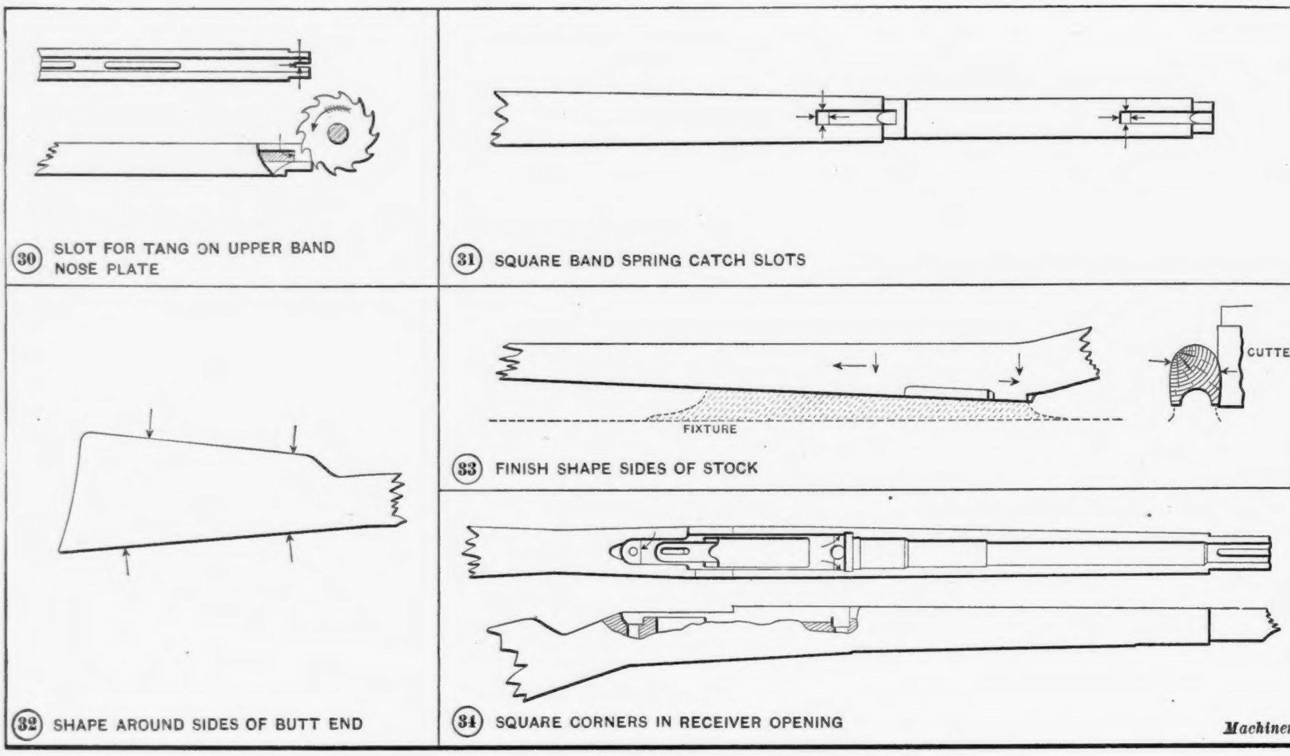


Fig. 63. Operations on Spanish Mauser Rifle Stock (Continued)

similar to those on the stock, with the exception of the inletting operation. For the finishing operations the groove and top face act as locating and gaging points.

Operation 1: Plane One Side of Block.—This operation is accomplished on a 16-inch hand-fed jointer, in which a three-blade type of cutter-head is used to straighten up one side of the piece.

Operation 2: Rip to Seven Taper Blanks.—This is accomplished by a slide-table saw, using a special hollow-ground saw. The table has guides for controlling the dimensions of the pieces being cut up.

Operation 3: Saw to Turning Length.—This is done on a double-ended or equalizing saw that cuts off both ends at the same time.

Operation 4: Rout and Bed Barrel Groove.—This operation is accomplished on a barrel routing and bedding machine, which is operated in a somewhat similar manner to the machine described for inletting the groove for the barrel in the stock, with the exception that it has fewer spindles and uses a much shorter bedding cutter-bar.

Operation 5: Face to Center Line of Barrel Groove.—This is accomplished on a two-spindle vertical shaping machine, only one spindle of which is used. The hand guard is held in a special fixture and the machining is done with a three-blade cutter-head.

Operation 6: Turn Outside Diameter—Two at a Time.—This is done in a semi-automatic gun stock lathe with a special holding fixture for holding two hand guards. These pieces are gripped from the end by a clamping device, and the turning is done with a special cutter-head having blades arranged spirally on the head.

Operation 7: Cut Off Stubs to Length.—This operation is accomplished on a double-ended equalizing saw, using a special fixture for holding the work. The stubs are cut off so as to bring the hand guard to approximately the required length. The stubs were used in the previous operation for clamping the two pieces to the holding fixture while turning the external diameter.

Operation 8: Gaine Sight Slide Clearance Flat.—This is accomplished on a single-head semi-automatic gaining machine in which the work is held in a special fixture, and the flat is cut with a series of cutters held in a special cutter-head.

Operation 9: Groove Sighting Clearance.—This operation is also accomplished on a gaining machine, using a special fixture for holding the work and a special cutter-head.

Operation 10: Inlet for Sight Base.—This is done on a three-spindle inletting machine, using a special fixture for holding the work.

Operation 11: Square Out Corners for Sight Base.—This operation is accomplished on the bench by means of hand tools. While the corners are being squared out, the groove in the front end of the guard for clearing the stock mortise band is also finished.

Operation 12: Gaine Stock Mortise Band Clearance.—This is accomplished on a gaining machine of the single-head semi-automatic type in which the work is held in a special fixture and the cutting is done with a three-blade cutter-head.

Operation 13: Hand Sandpaper.—This is done on the bench and consists in sandpapering the hand guard with No. 0 sandpaper.

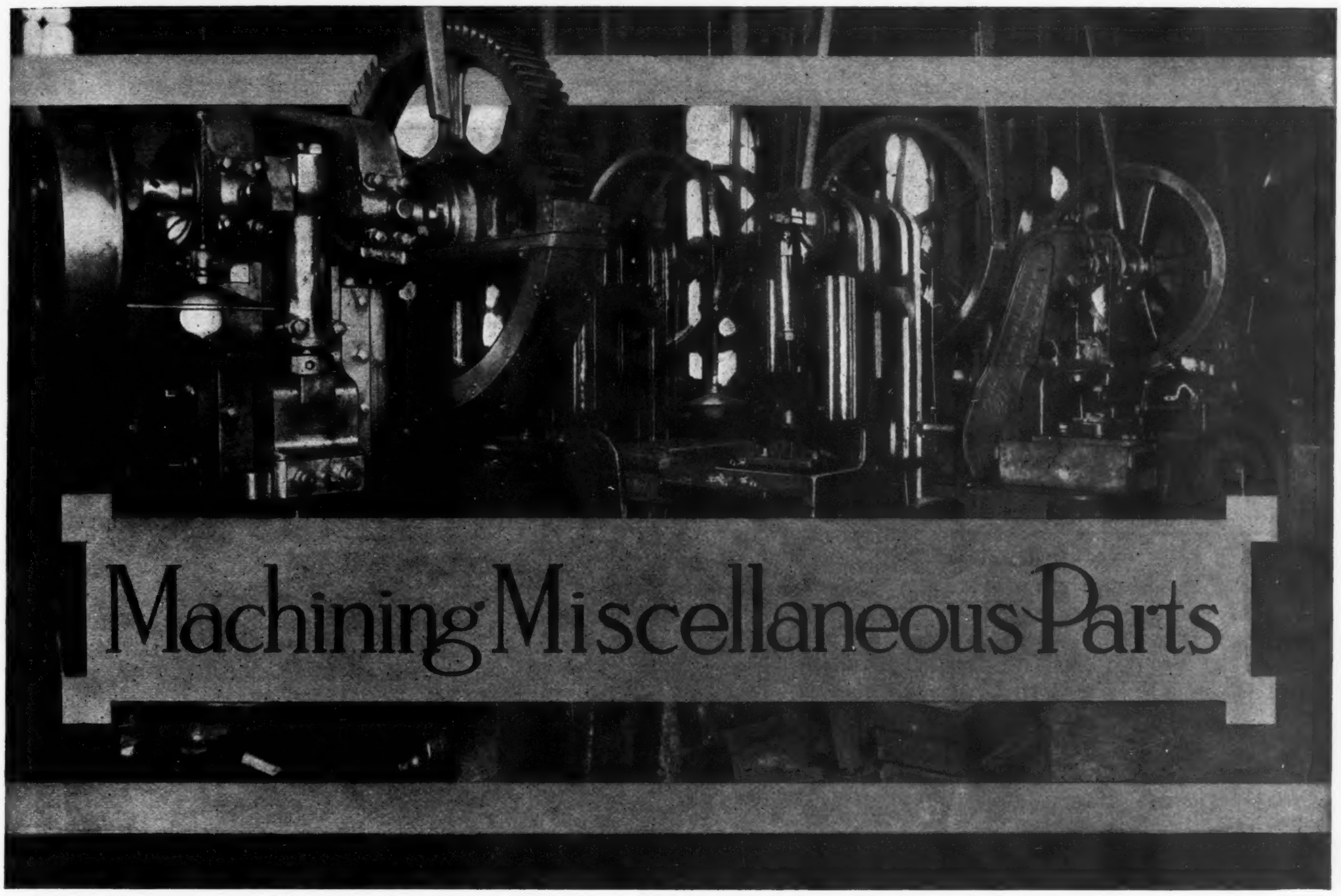
Operation 14: Polish.—This operation is accomplished in a polishing lathe with a cotton wheel rotated at 5500 surface feet per minute. No polishing material is used on the wheel.

Operation 15: Oil.—This consists in dipping the hand guards into tanks and allowing them to remain immersed until the linseed oil has soaked in.

Operation 16: Wipe.—This consists in wiping off the excess linseed oil with cotton waste.

Operation 17: Inspect.—This consists in giving the hand guard a final inspection for size and other defects.

In the preceding description, it will be noticed that no reference was made to machine sandpapering. In the general wood-working industry, there are two principal methods used for this work. One consists in using a drum to which sandpaper is fastened; this can only be used for sandpapering portions that are straight, and not of irregular outline. The other, which is known as the strap method, makes use of a belt mounted on pulleys which can be adjusted to keep the belt taut. The exposed surface of this belt is coated with special sand crystals of the desired "grain." The first method has been used with success for sandpapering the fore end of rifle stocks, and in some cases the second method has been used for sandpapering the irregular surfaces of the stock. In connection with the manufacturing operations outlined, neither of these methods has been recommended for the reason that the specifications for military rifle stocks are more exacting as regards interchangeability than as regards surface finish. An endeavor is made as far as possible to do all the machining by the cutters, which leaves little or no feed marks, and then to smooth the upper surfaces by hand with sandpaper. This is to prevent gouging of the stock, which sometimes occurs when using the belt sandpapering method.



OPERATIONS ON BUTT PLATE

THE butt plate (see Fig. 66) is made from a forging of gun steel. This part can either be produced by forging direct or can be made from a blank upset in a power upsetting and forging machine; the latter method has been adopted in this case. After blanking and upsetting, the upset part is again heated and bent to shape, after which it is annealed and pickled. As the inner surfaces of this butt plate which lie next to the stock are not machined, a second forging is necessary. This is done with the work at a temperature of about 900 degrees F. The part is then allowed to cool off gradually, ready for machining. The first machining operations consist in drilling and reaming the screw holes which act as locating and gaging points for subsequent operations.

Operation 1: Blank.—This operation is accomplished on a No. 5 "Stiles" punch press, using a blanking punch and die.

Operation 2: Upset, Hot.—This is accomplished on a 2-inch upsetting and forging machine, using the ordinary type of gripping dies. The work is heated to about 1600 degrees F.

Operation 3: Bend, Hot.—This is done on a No. 5 "Stiles" punch press, using a bending punch and die. For bending, the piece is heated to about 1200 degrees F.

Operation 4: Anneal and Pickle.—See "Anneal" and "Pickle."

Operation 5: Re-strike, Hot.—This operation is performed on an 800-pound drop-hammer, and consists in re-striking the part so as to smooth up the inner surface and make machining unnecessary. The work is heated not higher than 900 degrees F.

Operation 6: Drill, Ream and Countersink Screw Holes.—This is accomplished on a three-spindle sensitive drilling machine, using a special jig with feet on two sides.

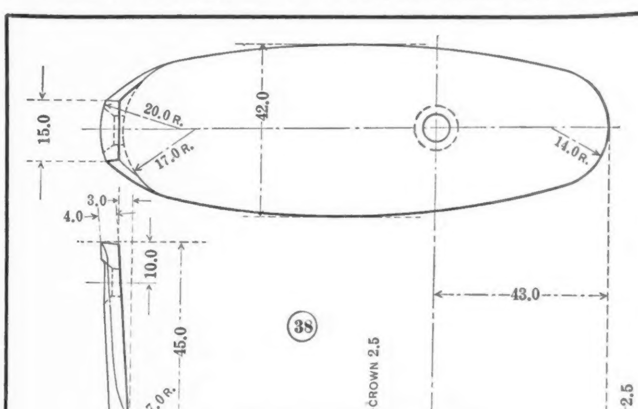
Operation 7: Profile Contour, Rough and Finish.—This is done on a two-spindle profiling machine, using a special fixture and a roughing and finishing profiling cutter.

Operation 8: Mill Circular Surface on Tang.—This is accomplished on a Lincoln type milling machine with a special fixture that holds two pieces. Two form milling cutters are used.

Operation 9: Profile Outline on Tang, Rough and Finish.—This operation is performed on a two-spindle profiling machine, using a special fixture for holding the work with the tang in a horizontal position. This necessitates using profiling cutters that are larger at the lower end than at the shank.

Operation 10: Profile Rear End Form, Rough and Finish.—This is accomplished on a two-spindle profiling machine, using a special fixture provided with a guide which controls the movement of the profiling cutters. The cutters are about 1½ inch in diameter, and have tangs, the regular profiling pins not being used.

TABLE XXIX. OPERATIONS ON BUTT PLATE—PART NO. 38



Oper. No.	Operation	Mach. Used	Tool or Fixture	Speed, Surface Feet per Min.	Feed per Rev., Inches	Hourly Product per Mach.	Machs. per Operator
1	Blank	No. 5 punch press	Blanking punch and die	60 st'k's	Hand	300	1
2	Upset, hot	2-inch upsetting and forging mach.	Forging dies and plunger	70 st'k's	Hand	160	1
3	Bend, hot	No. 5 punch press	Bending punch and die	60 st'k's	Hand	200	1
4	Anneal and pickle	Anneal. furn. Pickling bath	......	..	..	50	See text
5	Re-strike, hot	800-lb. drop-hammer	Forging dies	..	..	50	1

TABLE XXIX. OPERATIONS ON BUTT PLATE—(CONTINUED)

Oper. No.	Operation	Mach. Used	Tool or Fixture	Speed, Surface Feet per Min.	Feed per Rev., Inches	Hourly Product per Mach.	Machs. per Operator
6	Drill, ream and counter-sink screw holes	3-spindle sensitive drill. mach.	Spec. jig	30-70	Hand	40	1
7	Profile contour, rough and finish	2-spindle profiling mach.	Spec. fixt.	70-90	Hand	15	1
8	Mill circular surface on tang	Lincoln type mill. mach.	Spec. fixt. holds two pieces	60	0.040	60	2
9	Profile outline on tang, rough and finish	2-spindle profiling mach.	Spec. fixt.	70-90	Hand	20	1
10	Profile rear end form, rough and finish	2-spindle profiling mach.	Spec. fixt. Spec. cutters	60	Hand	20	1
11	Stamp	Bench work	Hand stamps	..	..	250	1
12	File and burr	Bench work	Files	..	..	50	1
13	Polish	Polishing lathe	Leather cov. wheels	5000	Hand	40	1
14	Blue	Niter bath	......	..	..	See text	

Operation 11: Stamp.—The number is stamped on the part.

Operation 12: File and Burr.—This is a hand operation, consisting in removing the burrs and sharp corners.

Operation 13: Polish.—See "Polish."

Operation 14: Blue.—See "Blue—Niter Process."

OPERATIONS ON SEAR

The sear (Fig. 33, April MACHINERY) must be hardened and tempered and is made from crucible or lockwork steel as

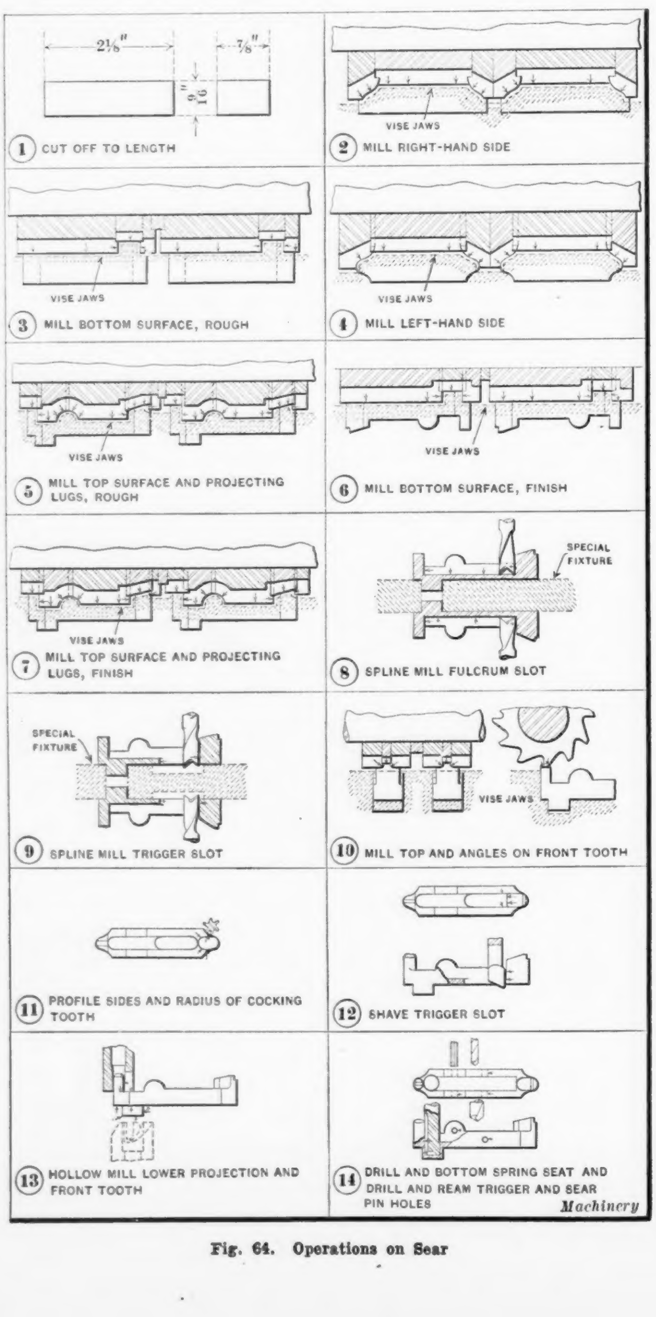
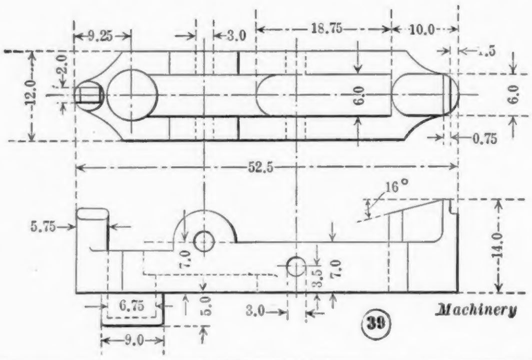


Fig. 64. Operations on Sear

TABLE XXX. OPERATIONS ON SEAR—PART NO. 39



Oper. No.	Operation	Mach. Used	Tool or Fixture	Speed, Surface Feet per Min.	Feed per Rev., Inches	Hourly Product per Mach.	Machs. per Operator
1	Cut off to length	Punch press	Shearing punch and die	60 st'k's	Hand	1500	1
2	Mill right-hand side	Lincoln type mill. mach.	Spec. vise jaws; hold two pieces	30	0.040	60	2
3	Mill bottom surface, rough	Lincoln type mill. mach.	Spec. vise jaws; hold two pieces	30	0.040	90	2
4	Mill left-hand side	Lincoln type mill. mach.	Spec. vise jaws; hold two pieces	30	0.040	60	2
5	Mill top surface and projecting lugs, rough	Lincoln type mill. mach.	Spec. vise jaws; hold two pieces	30	0.032	55	2
6	Mill bottom surface, finish	Lincoln type mill. mach.	Spec. vise jaws; hold two pieces	35	0.032	80	2
7	Mill top surface and projecting lugs, finish	Lincoln type mill. mach.	Spec. vise jaws; hold two pieces	35	0.032	70	2
8	Spline-mill fulcrum slot	P. & W. spline mill. mach.	Spec. fixt. holds two pieces	40	0.005	35	3
9	Spline-mill trigger slot	P. & W. spline mill. mach.	Spec. fixt. holds two pieces	40	0.005	60	2
10	Mill top and angles on front tooth	Hand mill. mach.	Spec. vise jaws; hold two pieces	40	Hand	45	1
11	Profile sides and radius of cocking-tooth	One-spindle profiling mach.	Spec. fixt.	40	Hand	40	1
12	Shave trigger slot	P. & W. vertical bench shav. mach.	Spec. fixt.	60 st'k's	..	50	1
13	Hollow-mill lower projection and front tooth	Two-spindle drilling mach.	Spec. jig	25	Hand	35	1
14	Drill and bottom spring seat, and drill and ream trigger and sear pin hole	Four-spindle sensitive drill. mach.	Spec. jig	20-35	Hand	35	1
15	Stamp	Bench work	Hand stamps	..	..	250	1
16	File and burr	Bench work	Files	..	..	45	1
17	Harden and temper	Hard. fur. Temp. bath	......	..	..	150	..
18	Tumble	Tumbling barrel	......	20 R.P.M.	..	100	6

shown in Table IV. The first operation is to shear off pieces of the required length from a 7/8 by 9/16 inch rectangular bar of hot-drawn stock. The piece is then finish-milled on one side and rough-milled on the bottom, after which it is finish-milled on the opposite side. The sides and the bottom then act as locating surfaces while milling the top. The bottom and top are then finish-milled and in the subsequent machining and gaging operations the sides and the bottom surfaces act as the locating points. For feeds, speeds, production, etc., see Table XXX.

Operation 1: Cut Off to Length.—This operation is accomplished on a punch press, using a shearing punch and die. The press is operated at about sixty strokes a minute.

Operation 2: Mill Right-hand Side.—This is done on a Lincoln type milling machine, using a quick-acting vise with special jaws. The jaws are made to hold two pieces and formed milling cutters mill the side surfaces and the curve on each end.

Operation 3: Mill Bottom Surface, Rough.—This operation is performed on a Lincoln type milling machine, using a quick-acting vise with special jaws that hold two pieces. Three milling cutters are used for each piece, six being held on the arbor at once.

Operation 4: Mill Left-hand Side.—This is similar to Operation 2.

Operation 5: Mill Top Surface and Projecting Lugs, Rough.—This operation is accomplished on a Lincoln type milling machine, using a quick-acting vise with special jaws that hold two pieces. Formed milling cutters are used.

Operation 6: Mill Bottom Surface, Finish.—This is similar to Operation 3.

Operation 7: Mill Top Surface and Projecting Lugs, Finish.—This is accomplished in a similar manner to Operation 5.

Operation 8: Spline-mill Fulcrum Slot.—This is accomplished on a Pratt & Whitney spline milling machine, using a special fixture that holds two pieces.

Operation 9: Spline-mill Trigger Slot.—This is done on a Pratt & Whitney spline milling machine, using a special fixture. The milling is done with fish-tail cutters.

Operation 10: Mill Top and Angles on Front Tooth.—This is accomplished on a hand milling machine, using form milling cutters. A special fixture is used that holds two pieces.

Operation 11: Profile Sides and Radius of Cocking-tooth.—This operation is accomplished on a one-spindle profiling machine, using a special former plate.

Operation 12: Shave Trigger Slot.—This is accomplished on a Pratt & Whitney vertical bench shaving machine, using a special fixture.

Operation 13: Hollow-mill Lower Projection and Front Tooth.—This operation is performed on a two-spindle drilling machine. A special jig is used to hold the piece with bushings to receive and locate the hollow-milling tools.

Operation 14: Drill and Bottom Spring Seat, and Drill and Ream Trigger and Sear Pin Holes.—These operations are accomplished on a four-spindle sensitive drilling machine, using a special jig for holding the piece.

Operation 15: Stamp.—This operation consists in stamping the number on the part by hand.

Operation 16: File and Burr.—This is a hand operation.

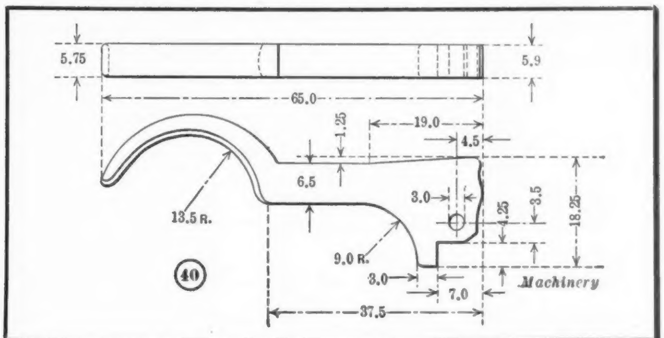
Operation 17: Harden and Temper.—See "Harden" and "Temper."

Operation 18: Tumble.—See "Tumble."

OPERATIONS ON TRIGGER

The trigger (see Fig. 33, April MACHINERY) is made from crucible or lockwork steel and is hardened and tempered. The top end is tempered just enough to relieve the strain, and the finger piece is drawn to a dark blue. The first machining operation consists in cutting out blanks of the required size and shape, leaving about 1/32 inch for finishing by milling. The blanks are then ground on both sides, after which the rear form is milled. The trigger pin hole is then drilled and reamed. The trigger pin hole and rear surface act as locating points for the subsequent machining and gaging operations. For additional details on feeds, speeds and production, see Table XXXI. The sequence of operations is illustrated in Fig. 65.

TABLE XXXI. OPERATIONS ON TRIGGER—PART NO. 40



Oper. No.	Operation	Mach. Used	Tool or Fixture	Speed, Surface Feet per Min.	Feed per Rev., Inches	Hourly Product per Mach.	Machs. per Operator
1	Blank	No. 5 punch press	Blanking punch and die	60 st'k's	Hand	1000	1
2	Surface-grind both sides	Blanchard surf. grinder	Magnetic chuck	See text		250	1
3	Mill rear form	Lincoln type mill. mach.	Spec. vise and jaws	30	0.032	60	2
4	Drill and ream pin hole	Two-spindle sensitive drill. mach.	Spec. jig	15-30	Hand	70	1
5	Mill front form	Lincoln type mill. mach.	Spec. vise and jaws	30	0.032	60	2
6	Mill top form, rough and finish	Lincoln type mill. mach.	Spec. vise and jaws	30	0.032	60	2
7	Mill stop lug	Hand mill. mach.	Spec. vise and jaws	30	Hand	70	1
8	Profile finger piece radius	Two-spindle profiling mach.	Spec. fixt. holds two pieces	35	Hand	45	1
9	Profile serrations in finger piece	One-spindle profiling mach.	Spec. fixt. holds two pieces	35	Hand	60	1
10	Stamp	Bench work	Hand stamps	..	..	250	1
11	File and burr	Bench work	Files	..	..	60	1
12	Polish	Polishing lathe	Leather cov. wheels	4500	..	40	1
13	Harden	Hard. furn.	......	..	..	200	1
14	Polish	Polishing lathe	Leather cov. wheels	4500	..	60	1
15	Temper	Niter bath	Tongs	..	..	40	1

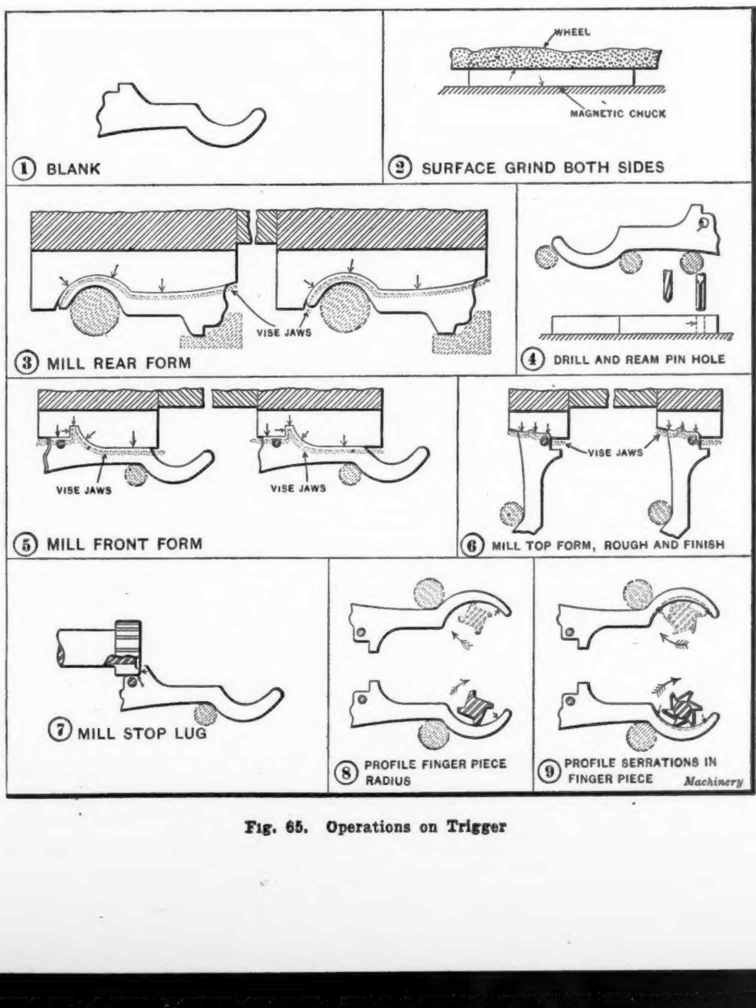


Fig. 65. Operations on Trigger

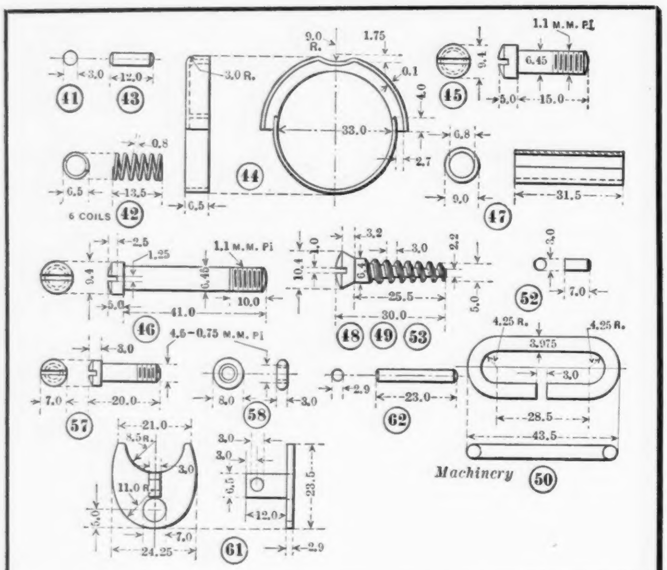
Operation 1: Blank.—This is accomplished on a No. 5 "Stiles" punch press, using a punch and die made from a high-grade tool steel, such as "purple Label Styrian." The stock is cut into strips of about five feet in length and is reversed after running through once, being fed by hand. Stock of a width slightly greater than the length of the trigger is used, and by reversing the stock considerable material is saved owing to the irregular shape of the part.

Operation 2: Surface-grind Both Sides.—These operations are accomplished on a Blanchard vertical surface grinder, which holds 175 pieces on the magnetic chuck. The wheel is 16 inches in diameter by 1¼ inch rim, grain 24, grade ¾ silicate, corundum, operating at 4190 feet surface speed per minute. The table speed is 13 R. P. M., roughing; 5 R. P. M., finishing. The down feed of the wheel is 0.001 inch per revolution of the table. The amount of material removed from each side is 0.015 to 0.030. The limits are $\pm$ 0.001 inch. The piece is ground with a taper on each side of about 0.004 inch.

Operation 3: Mill Rear Form.—This is done on a Lincoln type milling machine, using a quick-acting vise with special jaws that hold two pieces. Two eccentrically relieved high-speed milling cutters are used.

Operation 4: Drill and Ream Pin Hole.—This operation is performed on a two-spindle sensitive drilling machine, using an open type of jig with legs on both

TABLE XXXII. OPERATIONS ON MISCELLANEOUS SCREWS, PINS, ETC.



Part No.	Operation	Machine Used	Hourly Product per Mach.	Machs. per Operator
41, 43	Form, cut off and burr	Auto. forming mach. with burring attach.	1000	2
41, 43	Harden and temper	Hard. furn. Temp. bath	250	2
42	Coil, set and cut off	No. 1 spring coiling mach.	5000	4
42	Spring temper	Temper. bath	200	1
44	Blank and pierce	Punch press	1000	1
44	Draw	Punch press	1000	1
44	Trim lower end	Punch press	1000	1
44	Mill off inner flange	Hand mill. mach.	50	1
44	Polish	Polishing lathe	50	1
44	Blue	Niter bath	..	..
45	Form, turn, thread, cut off and slot	Auto. screw mach. with slotting attach.	100	3
45	Polish	Polishing lathe	120	1
45	Blue	Niter bath	..	..
46	Form, turn, thread, cut off and slot	Auto. screw mach. with slotting attach.	70	3
46	Polish	Polishing lathe	120	1
46	Blue	Niter bath	..	..
47	Turn, center, drill, ream, cut off and burr	Auto. screw mach. with slotting attach.	60	3
48-49-53	Turn, form, thread, and cut off	Hand screw mach. with thread chasing attach.	45	1
48-49-53	Shave head	No. 1 screw shav. mach.	120	1
48-49-53	Slot head	Screw slotting mach.	200	1
48-49-53	Blue	Niter bath	..	..
50	Cut off and form	No. 2 wire forming mach.	4500	4
50	Blue	Niter bath	..	..
52	Form, cut off and burr	Auto. forming mach. with burring attach.	1000	2
52	Harden and temper	Hard. furn. Temp. bath	250	2
57	Form, turn, thread, cut off and slot	Auto. screw mach. with slotting attach.	200	3
57	Polish	Polishing lathe	120	1
57	Blue	Niter bath	..	..
58	Form, spot, drill, tap, cut off and burr	Auto. screw mach. with burring attach.	250	3
58	Polish	Polishing lathe	120	1
58	Blue	Niter bath	..	..
61	Blank and pierce plate	Punch press	1000	1
61	Blank tang	Punch press	2500	1
61	Electric spot weld tang to plate	Butt welding mach.	60	1
61	Mill off burr	Hand mill. mach.	100	1
61	Drill hole in tang	One-spindle drill. mach.	200	1
61	File and burr	Bench work	60	1
61	Polish	Polishing lathe	150	1
61	Blue	Niter bath	..	..
62	Form, cut off and burr	Auto. forming mach. with burring attach.	1000	2
62	Harden and temper	Hard. furn. Temp. bath	200	2

sides so that the drilling can be done from one side and the reaming from the other.

Operation 5: Mill Front Form.—This is accomplished in a similar manner to Operation 3.

Operation 6: Mill Top Form, Rough and Finish.—This is done on a Lincoln type milling machine, using a quick-acting vise with special jaws that hold two pieces. The pieces are roughed in one side of the vise and finished in the other.

Operation 7: Mill Stop Lug.—This operation is accomplished on a hand milling machine, using a quick-acting vise that has special jaws.

Operation 8: Profile Finger Piece Radius.—This is accomplished on a two-spindle profiling machine, using a roughing and finishing cutter. Two pieces are held in the fixture at one time, and roughing and finishing cuts are taken from each.

Operation 9: Profile Serrations in Finger Piece.—This is performed on a one-spindle profiling machine, using a special fixture that holds two pieces. The cutter is shaped somewhat like a hob, having a series of concentric teeth located on its periphery.

Operation 10: Stamp.—This is a hand operation, consisting in stamping the numbers on the part.

Operation 11: File and Burr.—This consists in removing the burrs and sharp corners from the part.

Operation 12: Polish.—See "Polish."

Operation 13: Harden.—See "Harden."

Operation 14: Polish.—See "Polish."

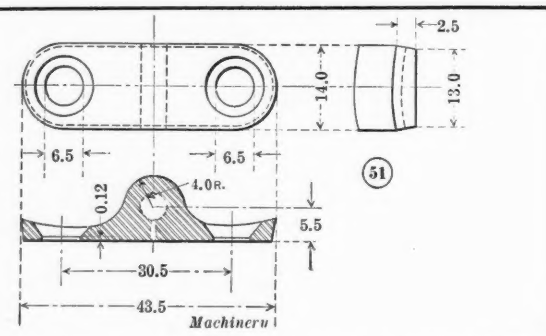
Operation 15: Temper.—In this operation the pieces are dipped in a niter bath with the finger piece down. They are held in a pair of tongs, and one piece is dipped at a time and allowed to remain in the bath until the top part of the trigger has reached a light straw color. It is then removed and immersed in water or oil.

OPERATIONS ON BUTT SLING SWIVEL BLOCK

The butt sling swivel block (see Fig. 66) is made from a hot-drawn bar of gun steel 7/16 inch thick by 1 3/4 inch wide. The most economical method of making this part is to rough out strips to the approximate shape and then cut them up into blocks of a width slightly greater than that of the finished piece. For making this particular part, strips 5 9/32 inches long are used. These are cut up in a cutting-off machine, and the first machining operation consists in milling the top surface. Then the bottom surface is milled and the strips are milled on the ends and cut up into eight pieces. The holes are now drilled and reamed, the screw holes acting as locating points for the subsequent machining operations. For speeds, feeds and production, see Table XXXIII.

Operation 1: Cut Off to 5 9/32 Inch Lengths.—This operation

TABLE XXXIII. OPERATIONS ON BUTT SLING SWIVEL BLOCK—PART NO. 51



Oper. No.	Operation	Mach. Used	Tool or Fixture	Speed, Surface Feet per Min.	Feed per Rev., Inches	Hourly Product per Mach.	Machs. per Operator
1	Cut off to 5 9/32-inch lengths	Cutting-off mach.	Insert-tooth H. S. steel	40	0.060	480	2
2	Mill right-hand edge of strip	Lincoln type mill. mach.	Spec. vise jaws	60	0.040	960	2
3	Mill left-hand edge of strip	Lincoln type mill. mach.	Spec. vise jaws	60	0.040	960	2
4	Mill top surface of strip	Lincoln type mill. mach.	Special fixt. holds two strips	60	0.040	240	3
5	Mill bottom surface of strip	Lincoln type mill. mach.	Special fixt. holds two strips	60	0.040	240	3
6	Cut up into eight pieces	Lincoln type mill. mach.	Vise jaws; hold four strips	50	0.032	400	2
7	Drill and ream screw holes, swivel hole and swivel pin hole	Six-spindle sensitive drill. mach.	Drill jig	30-60	Hand	25	1
8	Profile outline, rough and finish	Two-spindle profiling mach.	Special magnetic fixt.	70	Hand	30	1
9	Profile bottom surface, rough and finish	Two-spindle profiling mach.	Special magnetic fixt.	70	Hand	25	1
10	Countersink screw holes	One-spindle sensitive drill. mach.	Holding fixt.	50	Hand	60	1
11	Stamp	Bench work	Hand stamps	..	..	250	1
12	Polish	Polishing lathe	Leather cov. wheels	5000	Hand	75	1
13	Blue	Niter bath	......	..	..	See text	

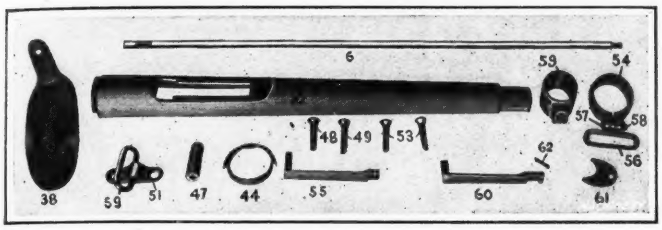


Fig. 66. Miscellaneous Parts used on Spanish Mauser Rifle

is accomplished on a cutting-off machine, using a high-speed steel inserted-tooth cutter. Six pieces are held in the vise at one time.

Operation 2: Mill Right-hand Edge of Strip.—This is accomplished on a Lincoln type milling machine, holding six strips in special vise jaws, and milling lengthwise of the strip.

Operation 3: Mill Left-hand Edge of Strip.—This is similar to Operation 2.

Operation 4: Mill Top Surface of Strip.—This operation is accomplished on a Lincoln type milling machine, using a special fixture that holds two strips.

Operation 5: Mill Bottom Surface of Strip.—This is similar to Operation 4, except that form milling cutters are used.

Operation 6: Cut Up into Eight Pieces.—This is accomplished on a Lincoln type milling machine, using a special vise with special jaws that hold four strips. The jaws are cut out so that the saws used for cutting up the strips pass through them. At the same time, the ends of the strips are milled.

Operation 7: Drill and Ream Screw Holes, Swivel Hole and Swivel Pin Hole.—These operations are accomplished on a six-spindle sensitive drilling machine, using a special jig of the invertible type with feet on three sides.

Operation 8: Profile Outline, Rough and Finish.—This is done on a two-spindle profiling machine, using a special magnetic fixture for holding the work. The work is located from the two screw holes. Two profiling cutters are used, one of which is straight and the other tapered.

Operation 9: Profile Bottom Surface, Rough and Finish.—This operation is accomplished on a two-spindle profiling machine, using roughing and finishing profiling cutters. The work is held on a special fixture designed to hold the work magnetically. Roughing and finishing cuts are taken from this surface.

Operation 10: Countersink Screw Holes.—This is done on a one-spindle sensitive drilling machine, using a special open jig for holding the work.

Operation 11: Stamp.—This consists in stamping the number on the part.

Operation 12: Polish.—See "Polish."

Operation 13: Blue.—See "Blue—Niter Process."

OPERATIONS ON LOWER BAND

The lower band (see Fig. 66) is drop-forged from a ½ by 1 inch rectangular hot-drawn bar of gun steel. After drop-forging, the part is trimmed, annealed and pickled, then both sides are ground on a vertical surface grinder, after which the hole is broached. In the subsequent operations, one face and the hole act as locating points. For additional details on feeds, speeds and production, see Table XXXIV.

Operation 1: Drop-forge and Trim.—This operation is accomplished by an 800-pound drop-hammer, using forging dies, and the trimming is done in a trimming press, using trimming punches and dies.

Operation 2: Anneal and Pickle.—See "Anneal" and "Pickle."

Operation 3: Grind Both Sides.—This is done on a Blanchard vertical surface grinder, which holds eighty pieces on the chuck at one time. The wheel is 16 inches in diameter, 1¼ inch rim, grain 24, grade 1, silicate corundum, operating at 4190 surface feet per minute. The feed of the table is 13 R. P. M., roughing; 5 R. P. M., finishing. The down feed of the wheel is 0.0012 inch per revolution of the table, and from 0.015 to 0.020 inch is removed from each side.

Operation 4: Broach Hole.—This operation is performed on a Lapointe duplex broaching machine, using a special fixture that holds two pieces. Two broaches are required to finish the work.

Operation 5: Profile Outline, Rough and Finish.—This is accomplished on a two-spindle profiling machine, using a special fixture for holding the work, and two form cutters, one for roughing and the other for finishing.

Operation 6: Profile Groove on Outline.—This is done on a one-spindle profiling machine, using a special fixture for holding the work and a special cutter for cutting the groove.

Operation 7: Mill Radius on Lug.—This operation is accomplished on a Lincoln type milling machine, using a special fixture that holds two pieces, and form milling cutters.

Operation 8: Straddle-mill Swivel Lug and Mill Slot.—This is done on a Lincoln type milling machine, using a special fixture that holds two pieces.

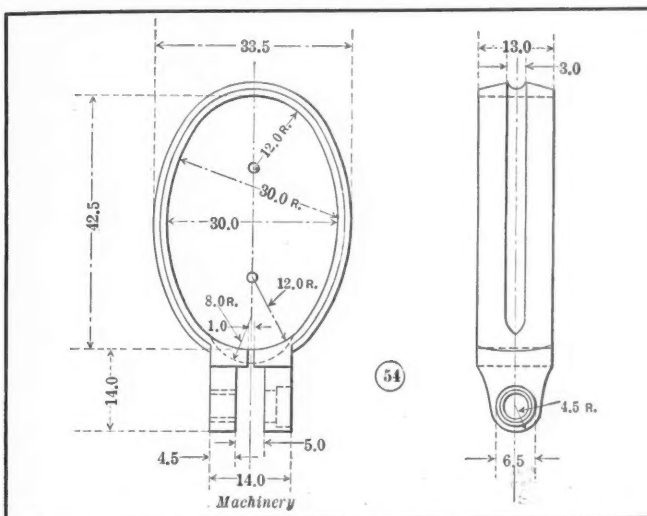
Operation 9: Mill Remainder of Outline.—This is accomplished on a hand milling machine, using a special radial fixture that holds one piece.

Operation 10: Mill Spring Catch Locking Slot.—This operation is accomplished on a hand milling machine, using a special fixture that holds one piece. The cutter-spindle is dropped down into the work without traversing the table.

Operation 11: Drill, Counterbore and Ream Swivel Screw Hole.—This is done on a three-spindle sensitive drilling machine, using a special jig for holding the work.

Operation 12: Tap Swivel Screw Hole.—This is accomplished on a bench tapping machine, using a special fixture for holding the work.

TABLE XXXIV. OPERATIONS ON LOWER BAND—PART NO. 54



Oper. No.	Operation	Mach. Used	Tool or Fixture	Speed, Surface Feet per Min.	Feed per Rev., Inches	Hourly Product per Mach.	Machs. per Operator
1	Drop-forge and trim	800-pound drop-hammer	Forg. and trim. dies	...	..	40	1
2	Anneal and pickle	Anneal. furn. Pickling bath	......	..	..	60	See text
3	Grind both sides	Blanchard surf. grinder	Magnetic chuck	See text		250	1
4	Broach hole	Lapointe duplex broach. mach.	Spec. fixt. holds two pieces	..	..	60	1
5	Profile outline, rough and finish	Two-spindle profiling mach.	Spec. fixt. Spec. cutters	70	Hand	20	1
6	Profile groove on outline	Single-spindle profiling mach.	Spec. fixt. Spec. cutter	70	Hand	45	1
7	Mill radius on lug	Lincoln type mill. mach.	Spec. fixt. holds two pieces	60	0.020	40	2
8	Straddle-mill swivel lug and mill slot	Lincoln type mill. mach.	Spec. fixt. holds two pieces	60	0.020	40	2
9	Mill remainder of outline	Hand mill. mach.	Spec. radial fixt.	60	Hand	50	1
10	Mill spring catch locking slot	Hand mill. mach.	Spec. fixt.	60	Hand	50	1
11	Drill, counterbore and ream swivel screw hole	Three-spindle sensitive drill. mach.	Drill jig	70	Hand	40	1
12	Tap swivel screw hole	Bench tapp. mach.	Spec. fixt.	20	Hand	50	1
13	Saw cut slot	Hand mill. mach.	Spec. fixt.	50	Hand	45	1
14	Stamp	Bench work	Hand stamps	..	250	..	1
15	File and burr	Bench work	Files	..	..	50	1
16	Polish	Polishing lathe	Leather cov. wheels	5000	..	40	1
17	Blue	Niter bath	......	..	See text		..

Operation 13: Saw Cut Slot.—This operation is performed on a hand milling machine, using a special fixture that holds one piece.

Operation 14: Stamp.—This consists in stamping the number on the part.

Operation 15: File and Burr.—This consists in removing all the sharp corners and burrs.

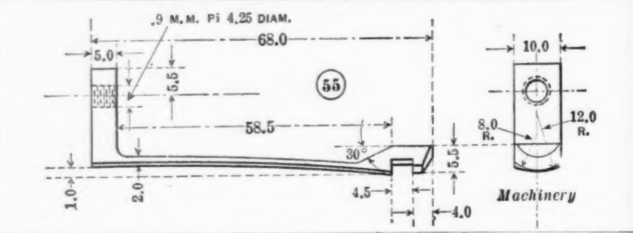
Operation 16: Polish.—See "Polish."

Operation 17: Blue.—See "Blue—Niter Process."

OPERATIONS ON LOWER BAND SPRING CATCH

The lower band spring catch (see Fig. 66) is drop-forged from a ½ by ⅜ inch rectangular hot-drawn bar of crucible or lockwork steel. Two heats are necessary, the first being a breaking-down operation and the second a finish-forging operation. After forging, trimming, annealing and pickling, the part is ready for machining. The first operation is to grind both sides on a Blanchard vertical surface grinder, providing a surface for milling the top outline and cleaning rod projection. This surface and the finished sides then act as locating points for the subsequent machining and gaging operations. For additional details on feeds, speeds and production, see Table XXXV.

TABLE XXXV. OPERATIONS ON LOWER BAND SPRING CATCH—PART NO. 55



Oper. No.	Operation	Mach. Used	Tool or Fixture	Speed, Surface Feet per Min.	Feed per Rev., Inches	Hourly Product per Mach.	Machs. per Operator
1	Drop-forge and trim	800-pound drop-hammer	Forg. and trim. dies	..	..	50	1
2	Anneal and pickle	Anneal. furn. Pickling bath	......	..	..	60	See text
3	Grind both sides	Blanchard surf. grinder	Magnetic chuck	See text		200	1
4	Mill top outline, cleaning rod projection and ends	Lincoln type mill. mach.	Spec. fixt. holds four pieces	50	0.032	80	2
5	Mill bottom surface	Lincoln type mill. mach.	Spec. fixt. holds two pieces	50	0.040	50	2
6	Mill locking catch slot	Hand mill. mach.	Spec. rotary fixt.	55	Hand	60	1
7	Mill locking catch radius and bevel end	Hand mill. mach.	Spec. rotary fixt.	60	Hand	70	1
8	Drill and tap cleaning rod hole	Two-spindle drilling mach.	Drill jig Tapp. attach.	20-60	..	40	1
9	Bend	Bench bending mach.	Bending dies	..	Hand	60	1
10	Stamp	Bench work	Hand stamps	..	Hand	250	1
11	File and burr	Bench work	Files	..	Hand	150	1
12	Harden and temper	Hard. furn. Temp. baths	......	..	..	150	1
13	Polish	Polishing lathe	Leather cov. wheels	5000	..	80	1
14	Blue	Niter bath	......	..	See text		..

Operation 1: Drop-forge and Trim.—This operation is accomplished on an 800-pound drop-hammer, using forging dies, the trimming being done on a trimming press with trimming punches and dies. Two forging heats are necessary to complete this part.

Operation 2: Anneal and Pickle.—See "Anneal" and "Pickle."

Operation 3: Grind Both Sides.—This is accomplished on a Blanchard vertical surface grinder, holding eighty pieces on the magnetic chuck. The wheel is 16 inches in diameter, 1¼ inch rim, grain 30, grade ¾, silicate corundum, operating at 4190 surface feet per minute. The table speed is 17 R. P. M., roughing; 5 R. P. M., finishing. The down feed of the wheel is 0.001 inch per revolution of the table. The amount removed from each side is 0.010 to 0.020 inch.

Operation 4: Mill Top Outline, Cleaning Rod Projection and Ends.—This operation is accomplished on a Lincoln type milling machine, using a special fixture that holds four pieces. The jaws of this fixture are cut away to clear the cutters used in facing off both ends of the pieces.

Operation 5: Mill Bottom Surface.—This is done on a Lincoln type milling machine, using a special fixture that holds two pieces. The cut is made lengthwise of the piece by form cutters.

Operation 6: Mill Locking Catch Slot.—This operation is accomplished on a hand milling machine, using a special rotary fixture that holds one piece.

Operation 7: Mill Locking Catch Radius and Bevel End.—This is done on a hand milling machine, using a special rotary fixture that holds one piece.

Operation 8: Drill and Tap Cleaning Rod Hole.—This operation is performed on a two-spindle sensitive drilling machine, using a tapping attachment.

Operation 9: Bend.—This is done in a bench bending fixture.

Operation 10: Stamp.—This is a hand operation, consisting in stamping the number on the part.

Operation 11: File and Burr.—This is a hand operation.

Operation 12: Harden and Temper.—See "Harden" and "Temper."

Operation 13: Polish.—See "Polish."

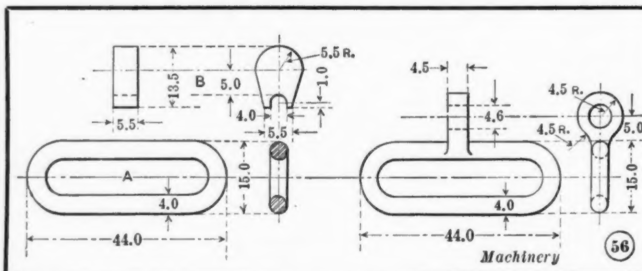
Operation 14: Blue.—See "Blue—Niter Process."

OPERATIONS ON LOWER BAND SWIVEL

The lower band swivel (see Fig. 66) can be most satisfactorily made from two pieces by electric welding. The first operation consists in making the swivel ring on a wire forming machine, the top part of the swivel being cut out in a punch press. Following electric welding, the projecting lug is straddle-milled and the hole is then drilled and reamed. For additional details, such as feeds, speeds and production, see Table XXXVI.

Operation 1: Cut Off and Bend Part A to Shape.—This operation is accomplished in an automatic wire-forming machine. Cold-rolled wire of the correct diameter is fed into the machine, cut off and bent to shape in one operation.

TABLE XXXVI. OPERATIONS ON LOWER BAND SWIVEL—PART NO. 56



Oper. No.	Operation	Mach. Used	Tool or Fixture	Speed, Surface Feet per Min.	Feed per Rev., Inches	Hourly Product per Mach.	Machs. per Operator
1	Cut off and bend Part A to shape	Wire forming mach.	Dies	..	..	4500	3
2	Butt-weld ends of Part A	Electric butt-weld. mach.	Special dies	..	..	150	1
3	Mill off fins left after welding on Part A	Hand mill. mach.	Spec. fixt. holds two pieces	70	Hand	60	1
4	Punch out Part B to shape	Punch press	Spec. dies	60 st'k's	..	1500	1
5	Butt-weld Parts A and B	Electric butt-weld. mach.	Punch and die	..	..	125	1
6	Mill contour on right-hand side of lug	Hand mill. mach.	Spec. fixt. holds one piece	70	Hand	50	2
7	Mill contour on left-hand side of lug	Hand mill. mach.	Spec. fixt. holds one piece	70	Hand	50	1
8	Straddle-mill lug	Hand mill. mach.	Spec. rotary fixt.	60	Hand	50	1
9	Drill and ream hole	Two-spindle sensitive drill. mach.	Drill jig	30-60	Hand	90	1
10	Stamp	......	Hand stamps	..	..	250	1
11	File and burr	......	Files	..	..	40	1
12	Polish	Polishing lathe	Leather cov. wheels	5000	..	30	1
13	Blue	Niter bath	......	..	See text		..

Operation 2: Butt-weld Ends of Part A.—This is done by an electric butt-welding machine of the chain welding type, in which the electrodes are presented at an angle to the work.

Operation 3: Mill Off Fins Left after Welding on Part A.—This is accomplished on a hand milling machine, using a special fixture that holds two pieces, and locating the work and gripping it from the loop hole.

Operation 4: Punch Out Part B to Shape.—This operation is performed on a punch press, using a punch and die.

Operation 5: Butt-weld Parts A and B.—This is accomplished by a butt-welding machine, using special shaped clamping electrodes.

Operation 6: Mill Contour on Right-hand Side of Lug.—This is done on a hand milling machine, using a special fixture that holds one piece, and a form milling cutter.

Operation 7: Mill Contour on Left-hand Side of Lug.—This is similar to Operation 6.

Operation 8: Straddle-mill Lug.—This operation is accomplished on a hand milling machine, using a rotary fixture and a straddle-milling cutter.

Operation 9: Drill and Ream Hole.—This is done on a two-spindle sensitive drilling machine, using a jig for holding the work.

Operation 10: Stamp.—This is a hand operation, consisting in stamping the number on the part.

Operation 11: File and Burr.—This is a hand operation.

Operation 12: Polish.—See "Polish."

Operation 13: Blue.—See "Blue—Niter Process."

OPERATIONS ON UPPER BAND

The upper band (see Fig. 66) is drop-forged from a 7/8-inch square hot-drawn gun steel bar, then trimmed, annealed and pickled. The first machining operation consists in grinding both sides on a Blanchard vertical surface grinder, after which the hole is broached, two pieces being broached at a time. The hole and the ground sides act as locating and gaging points for the subsequent machining operations. For additional details on feeds, speeds and production, see Table XXXVII.

Operation 1: Drop-forge and Trim.—This operation is performed on an 800-pound drop-hammer, using drop-forging dies, the trimming being done in a trimming press.

Operation 2: Anneal and Pickle.—See "Anneal" and "Pickle."

Operation 3: Grind Both Sides.—This is accomplished on a Blanchard vertical surface grinder, holding eighty pieces on the magnetic chuck. The wheel is 16 inches in diameter, 1¼ inch rim, grain 24, grade 1, silicate corundum, operating at 4190 surface feet per minute. The table speed is 13 R. P. M., roughing; 5 R. P. M., finishing. The down feed of the wheel is 0.0012 inch per revolution of the table and the amount removed is from 0.010 to 0.020 inch.

Operation 4: Broach Hole.—This is accomplished on a duplex Lapointe broaching machine, using two broaches.

Operation 5: Mill Right-hand Side and Bayonet Lock, Rough.—This operation is performed on a Lincoln type milling machine, using a special fixture that holds two pieces.

Operation 6: Mill Left-hand Side and Bayonet Lock, Rough.—This is performed in a similar manner to Operation 5.

Operation 7: Mill Right-hand Side and Bayonet Lock, Finish.—This is similar to Operation 5.

Operation 8: Mill Left-hand Side and Bayonet Lock, Finish.—This is similar to Operation 6.

Operation 9: Straddle-mill Bayonet Lock and Bevel.—This operation is accomplished on a Lincoln type milling machine, using a special fixture that holds two pieces.

Operation 10: Profile Radius on Bayonet Lock, Rough and Finish.—This is accomplished on a two-spindle profiling machine, using roughing and finishing profiling forms and cutters.

Operation 11: Mill Spring Catch Slot.—This is done on a hand milling machine, using a cutter of the required width and diameter. The cutter is dropped down into the work, and the table is not traversed.

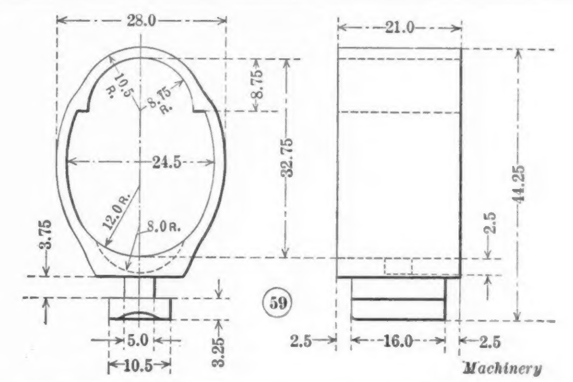
Operation 12: Stamp.—This is a hand operation, consisting in stamping the number on the part.

Operation 13: File and Burr.—This is a hand operation.

Operation 14: Polish.—See "Polish."

Operation 15: Blue.—See "Blue—Niter Process."

TABLE XXXVII. OPERATIONS ON UPPER BAND—PART NO. 59



Oper. No.	Operation	Mach. Used	Tool or Fixture	Speed, Surface Feet per Min.	Feed per Rev., Inches	Hourly Product per Mach.	Machs. per Operator
1	Drop-forge and trim	800-pound drop-hammer	Forg. and trim. dies	..	..	40	1
2	Anneal and pickle	Anneal. furn. Pickling bath	......	..	..	60	See text
3	Grind both sides	Blanchard surf. grinder		See text	25	250-300	1
4	Broach hole	Lapointe broach. mach.	Spec. fixt. holds two pieces	..	..	50	1
5	Mill right-hand side and bayonet lock, rough	Lincoln type mill. mach.	Spec. fixt. holds two pieces	60	0.040	60	2
6	Mill left-hand side and bayonet lock, rough	Lincoln type mill. mach.	Spec. fixt. holds two pieces	60	0.040	60	2
7	Mill right-hand side and bayonet lock, finish	Lincoln type mill. mach.	Spec. fixt. holds two pieces	70	0.032	60	2
8	Mill left-hand side and bayonet lock, finish	Lincoln type mill. mach.	Spec. fixt. holds two pieces	70	0.032	60	2
9	Straddle-mill bayonet lock and bevel	Lincoln type mill. mach.	Spec. fixt. holds two pieces	60	0.032	70	2
10	Profile radius on bayonet lock, rough and finish	Two-spindle profiling mach.	Spec. fixt.	70	Hand	45	1
11	Mill spring catch slot	Hand mill. mach.	Spec. vise jaws	60	Hand	50	1
12	Stamp	Bench work	Hand stamps	..	Hand	250	1
13	File and burr	Bench work	Files	..	Hand	50	1
14	Polish	Polishing lathe	Leather cov. wheels	5000	Hand	50	1
15	Blue	Niter bath	......	..	See text		..

OPERATIONS ON UPPER BAND SPRING CATCH

The upper band spring catch (see Fig. 66) is drop-forged from a ½ by ⅜ inch rectangular bar of crucible or lockwork steel. Two heatings are necessary for this part. After drop-forging, trimming, annealing and pickling, the first machining operation consists in grinding both sides on a Blanchard vertical surface grinder. The sides then act as clamping points while milling the top outline, the cleaning rod projection, and both ends. The finish-milled top surface and the sides act as locating points for the subsequent gaging and machining operations. For additional details on feeds, speeds and production, see Table XXXVIII.

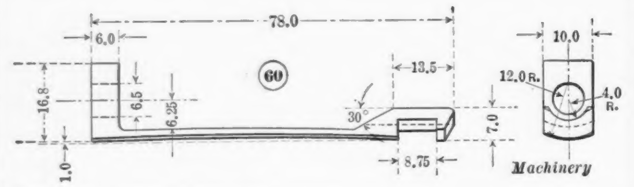
Operation 1: Drop-forge and Trim.—This operation is accomplished on an 800-pound drop-hammer, using forging dies; two heats are necessary for this piece because of the thin web in the center. The trimming is done in a trimming press, using a trimming punch and die.

Operation 2: Anneal and Pickle.—See "Anneal" and "Pickle."

Operation 3: Grind Both Sides.—This is accomplished on a Blanchard vertical surface grinder, holding eighty pieces on the magnetic chuck. The wheel is 16 inches in diameter, 1¼ inch rim, grade 30, grain ¾, silicate corundum, rotating at 4190 R. P. M. The table speed is 17 R. P. M., roughing; 5 R. P. M., finishing. The down feed of the wheel per revolution of the work is 0.001 inch. The amount to be removed from each side is 0.010 to 0.020 inch.

Operation 4: Mill Top Outline, Cleaning Rod Projection and Ends.—This is done on a Lincoln type milling machine, using a special fixture that holds four pieces.

TABLE XXXVIII. OPERATIONS ON UPPER BAND SPRING CATCH—PART NO. 60



Oper. No.	Operation	Mach. Used	Tool or Fixture	Speed, Surface Feet per Min.	Feed per Rev., Inches	Hourly Product per Mach.	Machs. per Operator
1	Drop-forge and trim	800-pound drop-hammer	Forg. and trim. dies	..	..	60	1
2	Anneal and pickle	Anneal. furn. Pickling bath	......	..	..	60	See text
3	Grind both sides	Blanchard surf. grinder	Magnetic chuck	See text		200-250	1
4	Mill top outline, cleaning rod projection and ends	Lincoln type mill. mach.	Spec. fixt. holds four pieces	50	0.032	80	2
5	Mill bottom surface	Lincoln type mill. mach.	Spec. fixt. holds two pieces	50	0.040	50	2
6	Mill cleaning rod clearance slot	Hand mill. mach.	Spec. fixt. Spec. cutter	50	Hand	60	1
7	Mill locking catch slot	Hand mill. mach.	Spec. rotary fixt.	60	Hand	70	1
8	Mill locking catch radius and bevel end	Hand mill. mach.	Spec. rotary fixt.	60	Hand	70	1
9	Drill and ream cleaning rod clearance hole	Two-spindle sensitive drill. mach.	Drill jig	30-60	Hand	60	1
10	Bend	Bench bending mach.	Bending dies	..	Hand	100	1
11	Stamp	Bench work	Hand stamps	..	Hand	250	1
12	File and burr	Bench work	Files	..	Hand	150	1
13	Harden and temper	Hard. furn. Temp. baths	......	..	..	150	1
14	Polish	Polishing lathe	Leather cov. wheels	5000	..	80	1
15	Blue	Niter bath	......	..	See tert		..

Operation 5: Mill Bottom Surface.—This operation is performed on a Lincoln type milling machine, using a special fixture that holds two pieces, the cut being made longitudinally. Two form milling cutters are used.

Operation 6: Mill Cleaning Rod Clearance Slot.—This is accomplished on a hand milling machine, using a special fixture and a form milling cutter.

Operation 7: Mill Locking Catch Slot.—This is done on a hand milling machine, using a special rotary fixture.

Operation 8: Mill Locking Catch Radius and Bevel End.—This operation is accomplished on a hand milling machine, using a special rotary fixture and a special form cutter.

Operation 9: Drill and Ream Cleaning Rod Clearance Hole.—This is accomplished on a two-spindle sensitive drilling machine, using a special jig for holding the work.

Operation 10: Bend.—This is done on a bench type bending machine, using a bending punch and die.

Operation 11: Stamp.—This consists in stamping the number on the part.

Operation 12: File and Burr.—This is a hand operation.

Operation 13: Harden and Temper.—See "Harden" and "Temper."

Operation 14: Polish.—See "Polish."

Operation 15: Blue.—See "Blue—Niter Process."

* * *

ELECTRICALLY HEATED JAPANNING OVENS

BY GEORGE B. MORRIS*

In selling the product of a factory engaged in any line of manufacture, perfection of finish is of almost as great importance as the mechanical perfection of its mechanism. A competitor often wins out with an inferior product because he has provided it with a durable finish; and the man who is making a really superior product would only have to pay attention to this detail in order to greatly increase his sales. Provided it is properly applied and baked, there is no better finish than ordinary black enamel—commonly called black "japan"—for bicycle frames, automobile parts, hardware specialties, and a great variety of other products. The articles to be japanned should be thoroughly cleaned to remove all dirt, dust and grease; and for this purpose sandblasting will be found to give satisfactory results. The method of applying the japan will necessarily vary according to the product; dipping will be found most satisfactory in those cases where this method can be employed; in other cases, spraying will give the best results; and in certain instances, it will be found necessary to apply the japan with a brush. By consulting any reliable manufacturer of japan, advice may be obtained as to the best method to employ; and this advice should be followed, as the method of applying the finish will vary with the nature of the japan as well as with the character of the product to which it is applied.

One of the most important factors in obtaining a satisfactory finish by japanning consists in baking the japan properly after it has been applied. The best grades should be baked at a temperature of from 350 to 375 degrees F., and it is not practical to use steam coils for this purpose. Gas burners are commonly employed, but this method has so many disadvantages that numerous firms have resorted to the use of japans which can be baked at a lower temperature, sacrificing the quality of the finish applied to their product in order to overcome the objectionable features of this method of baking. With the japans that can be baked at a low temperature, heat is applied by steam coils.

About three years ago the firm by which the writer was employed had a discouraging experience with its gas heated baking ovens, but rather than resort to the use of japans which could be baked at a low temperature and thus sacrifice the quality of finish on its product, the engineers of this firm started to experiment with electrically heated ovens for baking the japan. For this purpose some discarded street car heaters were purchased from a local traction company and substituted in place of the gas burners in the ovens. After successfully overcoming a few preliminary obstacles, the results obtained were found to be very satisfactory, and it was a matter of surprise that the cost of the current consumed was less than the expenditure formerly made in operating the gas burners. Another important advantage of the electrical ovens was that three times the amount of work could be turned out as compared with the former method. Furthermore, the finish obtained by baking the japan in the electrically heated ovens was superior to that produced in any other way, owing to the fact that a uniform temperature could be maintained with an electrical regulating device. After these experiments had been completed, all the other baking ovens were equipped with electric heating coils, and three years' experience with the use of these ovens has fully justified the judgment of the engineers in deciding to make the change.

It is not within the scope of this article to enter into a discussion of the method of figuring the current consumption for any size of ovens, but the experience of the company using the method will serve to give an idea of the cost of baking japan by this method. The ovens used were 3 feet wide by 9 feet, 6 inches long by 6 feet high, and were heated by fifteen coils which cost less than $3 each. The current consumed was a little less than 25 kilowatts, and at a price of one cent per kilowatt-hour, this would make the cost of operation 25 cents per hour while the oven is in actual use. This does not include the time spent in cooling, loading or unloading the oven. Roughly speaking, this figures out at one kilowatt for every seven cubic feet of oven capacity, and the cost of the coils for heating the oven may be taken at about $1 for each four feet of oven capacity.

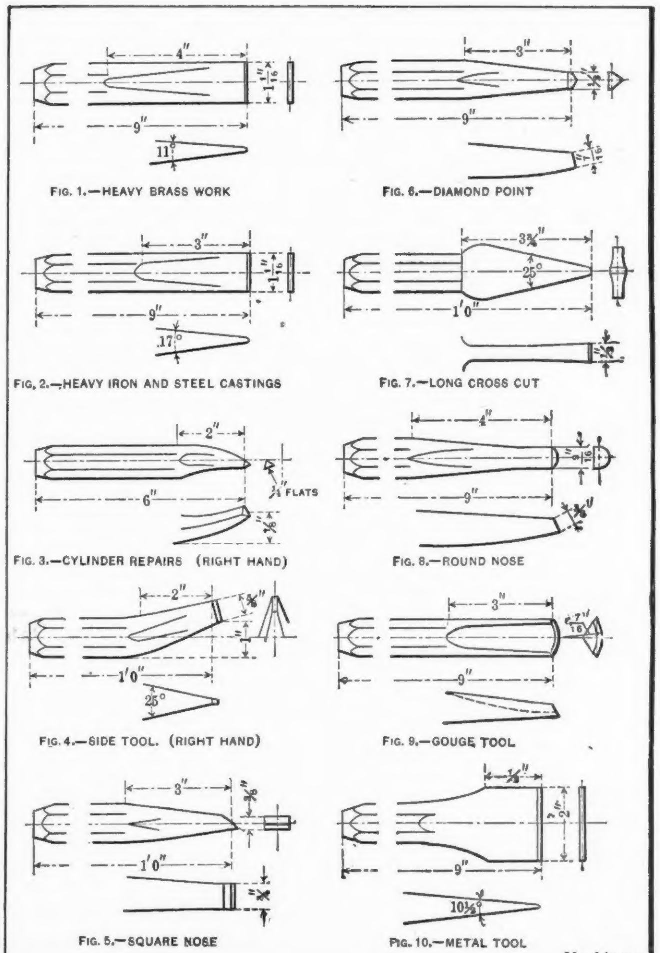
If it is found that the oven does not give sufficient heat to thoroughly bake the japan, it is an easy matter to add an extra coil at any time that it may be considered necessary to do so. All of the coils should be placed directly under the work, and the work is generally suspended in the oven while it is being baked. The coils should be protected by a perforated metal grating. In ordering coils for a japanning oven, it is merely necessary to tell the electrical contractor the current consumption required to heat the oven, as calculated by the preceding method, and the kind of current available in the factory in which the ovens are located.

* Address: Kenmore, N. Y.

CHISELS—SHAPES AND HEAT-TREATMENT*

Much attention has been given to the composition and treatment of tool steel used in machine tools, but the three implements of the hand worker—the file, the chisel and the hammer—have been comparatively neglected. Credit should be given for the work recently done in testing the file, and there is little need of improvement of the hammer, but the chisel has not received the systematic attention its importance deserves. A close examination of the new and used chisels in the shops of the Midland Ry., England, confirmed that view, and the result was an effort to induce the alloys research committee of the Institution of Mechanical Engineers to take up the matter, but it was not successful, and so the matter has been dealt with individually.

The material usually employed for chisels is not bought to specification, but a well-known and tried brand is purchased. In the chief mechanical engineer's department of the Midland Ry., after considerable experimenting, it was decided to order chisel steel to the following specifications: carbon, 0.75 per cent to 0.85 per cent, the other constituents being normal. This gives a complete analysis as follows: carbon, 0.75 to 0.85; manganese, 0.30; silicon, 0.10; sulphur, 0.025; phosphorus, 0.025.



Figs. 1 to 10. Forms of Chisels standardized for the Locomotive Shops of the Midland Ry., England

It is perhaps interesting to note that the analysis of a chisel which had given excellent service was as follows: carbon, 0.75; manganese, 0.38; silicon, 0.16; sulphur, 0.028; phosphorus, 0.026. The heat-treatment is unknown.

At the same time that chisel steel was standardized, the form of the chisels themselves was revised, and a standard chart of these as used in the locomotive shops was drawn up. Figs. 1 to 10 show the most important forms, which are made to stock orders in the smithy and forwarded to the heat-treatment room where the hardening and tempering is carried out on batches of fifty. A standard system of treatment is employed, which to a very large extent does away with the personal element. Since the chemical composition is more or less constant, the chief variant is the section which causes the temperatures to be varied slightly. The chisels are carefully heated in a gas-fired furnace to a temperature of from 730 to 740 degrees C. (1340 to 1364 degrees F.) according to section. In practice, the chisel, Fig. 1, is heated to 730 degrees C.; chisel, Fig. 2, to 735 degrees C. (1355 degrees F.); and a 1-inch half round chisel to 740 degrees C., because of their varying increasing thickness of section at the points. Upon attaining this steady temperature, the chisels are quenched to a depth of 3/8 to 1/2 inch from the point in water, and then the whole chisel is immersed and cooled off in a tank containing linseed oil. This oil-tank is cooled by being immersed in a cold-water tank through which water is constantly circulated. After this treatment, the chisels have a dead hard point and a tough or sorbitic shaft. They are then tempered or the point "let down." This is done by immersing them in another oil-bath which has been raised to about 215 degrees C. (419 degrees F.). The first result is, of course, to drop the temperature of the oil, which is gradually raised to its initial point. On approaching this temperature the chisels are taken out about every 2 degrees C. rise and tested with a file, and at a point between 215 and 220 degrees C. (428 degrees F.), when it is found that the desired temper has been reached, the chisels are removed, cleaned in sawdust, and allowed to cool in an iron tray.

No comparative tests of these chisels with those bought and treated by the old rule-of-thumb methods have been made, as no exact method of carrying out such tests mechanically, other than trying the hardness by the Brinell or scleroscope method, are known; any ordinary test depends so largely upon the dexterity of the operator. The universal opinion of foremen and those using the chisels as to the advantages of the ones receiving the standard treatment described is that a substantial improvement has been made. The chisels were not "normalized." Tests of chisels normalized at about 900 degrees C. (1652 degrees F.) showed that they possessed no advantage.

* Abstract of paper read by Henry Fowler, chief mechanical engineer of the Midland Ry., England, before the Institution of Mechanical Engineers, February 18.

* * *

CLEVELAND MILLING MACHINE CO.

The Cleveland Milling Machine Co., Cleveland, Ohio, is a new concern incorporated under the laws of Ohio with a capital of $100,000, of which $75,000 is paid up, for the purpose of manufacturing milling machines, milling cutters and special tools. It is headed by Frank S. Shields, president, and J. A. Camm, vice-president, both of whom are thoroughly familiar with the machine tool business. Mr. Shields, for the past six years, has been factory manager and sales manager of the National Tool Co. of Cleveland, manufacturer of milling cutters and small tools. Mr. Camm has been engaged in the machine tool business all his business life, having been identified with a number of Cincinnati companies and for the last seven years employed by the Kearney & Trecker Co. of Milwaukee, in various capacities, recently as sales manager.

The company has broken ground at 18511 Euclid Ave., Cleveland, in the heart of a new industrial section, where seven acres of land have been acquired near the New York Central & St. Louis Railroad tracks and the new White Farm Tractor Corporation. The factory will be erected on the unit system and will be of approved up-to-date construction. The first unit, 100 by 200 feet, saw-tooth roof construction, will be completed about May 1, and 100 men will be employed. Plans have been made for increasing the plant so as to provide for the employment of 1000 men by January 1, 1917.

The growth of this new machine tool concern, which will specialize in the building of milling machines and the manufacture of small tools of the highest quality, will be watched with much interest. The organization of the new company adds one more to the already extensive list of machine tool concerns in Cleveland building lathes, boring mills, planers, automatic screw machines, etc. The addition of a high-grade milling machine establishment will still further increase the scope of the machine tool business in the "Sixth City."

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ESTIMATING THE COST OF MACHINE WORK

The unscrupulous plumber has long been noted for spinning out jobs and charging high prices for work and material, and his craft is commonly regarded as conducting its business with as little system or regard for efficiency as can be found in any industry; but the following letter from a consulting mechanical engineer of wide experience indicates that some jobbing machinists are pressing the plumber hard for the inefficiency record:

We hear much about American manufacturing supremacy and the great things that we are doing. But an analysis of what we are accomplishing shows a lamentable lack of initiative and ability to estimate on the part of small manufacturers. By small manufacturers is meant establishments employing from ten to one hundred men. They simply cannot take a drawing or piece of machinery and analyze it piece by piece, and estimate the weight and cost of production or reproduction. This statement is based on the experience of years in attempting to get estimates on work from this class of men. As an individual example may serve as a demonstration of the truth of the statement, here is one.

I recently had a split cylinder to be made. The work involved the making of two half-cylinder patterns without core boxes. The machine work consisted of facing off the edges of the two half-cylinders where they came together; the drilling of holes by which they were to be bolted together; the boring out and facing of the ends and the drilling and tapping of stud holes in those ends. The length was about eighteen inches, and the bored diameter about ten inches. It was simple in every way, and any intelligent apprentice should have been able to make the estimate.

I sent complete drawings to ten machine shops. I received three bids for the work of $60, $90 and $150, respectively. In addition to these I received seven replies. Of these, two declined to make a bid and five quoted their regular hourly shop rates for machine work, which ranged from fifty cents to seventy-five cents an hour.

Of the ten firms there was only one whose bid checked with my own analysis of what the work should cost. That may have been an estimate or a guess; I don't know, and my own estimate may have been faulty, but the fact remains that only three out of the ten dared to give a price, and of those three, certainly not more than one could have been correct.

It looks as though there were a big field open for the education of machine shop owners in their own field of endeavor.

THE METRIC SYSTEM AGITATION

The report of Dr. Samuel W. Stratton, director of the Bureau of Standards, on the metric system has renewed the agitation which recurs periodically around that subject, and has stirred up vigorous protests from manufacturers whose business will be upset by any change. Henry R. Towne, in a recent letter to the New York *Evening Post*, says:

Decimal notation and the metric system are two distinct propositions, although very commonly confounded. The convenience of the metric system of weights and measures, especially in scientific work and in complex calculations, is largely due to its use of decimal notation, but still more to the interrelation of its units of length, volume and weight, whereas our present system lacks this latter admirable quality and permits of decimal notation only to a limited degree. On the other hand, for all the ordinary transactions of daily life, not the decimal but the *binary* system of division is in universal use, even in metric countries, and always will be, for the human mind naturally divides things into halves, quarters, etc.—not into tenths, hundredths, etc. Even in France today the unit of weight for domestic purposes is the livre (= one-half kilogram), and this is divided into half-livres, quarter-livres, etc.

No one denies the unfortunate complexity of our present system, nor its lack of coordination between the units of length, volume and weight, but neither can anyone deny that we now have that great desideratum which led France (and later Germany) to adopt the metric system, namely, *uniformity*—uniformity not only throughout our own country, but also, practically, throughout the British Empire.

The situation is one of great complexity, especially with regard to the export trade. To develop foreign trade it is necessary to conform to the system of weights and measures employed by the people to whom we sell, and that has been one strong feature of trade development by the Germans, who in that respect have always tried to please the customer rather than themselves. On the other hand, the English system of weights and measures is embedded in our practice and institutions, and any change, especially in the standard of measurement, would involve waste, expense and confusion for a long period. The change to the metric system is favored principally by scientists because of the interrelation of the units of length, volume and weight; but these interrelations are not of such importance in manufacturing practice as to warrant a revolution; in fact, they are virtually negligible.

The war orders placed with our machinery industry have familiarized some of our manufacturers and workmen with the metric system, and if the extension of our trade to foreign markets, where it is required, shows that it possesses advantages over the English system, the knowledge of those advantages will quickly spread and the metric system will establish itself by merit alone, which is the only basis that any system of measurement should stand upon.

* * *

SHOULD THE ENGINEER ADVERTISE?

Young engineers who are striving to build up a consulting practice frequently complain that the somewhat general prejudice against advertising by professional men places them at an unfair disadvantage in obtaining clients. They argue that there is no justice in making a distinction between advertising the services of an engineer and the products of manufacturers who seek his advice.

At first sight this may appear correct, but further investigation will show that there is an excellent reason for making the distinction. In seeking the advice of a consulting engineer, his reputation and experience constitute the most important means of guidance for the prospective client in making a selection. But this is not true to so great an extent with manufactured products, because the manufacturer's reputation is only one of several reliable criterions of value.

After accepting this principle as fair, the young engineer should not be long in seeing that his chance for advertising lies not in cleverly worded statements of his ability and experience, but in devoting to all of his work the necessary amount of time and care to insure satisfying every client. This is a form of advertising that will prove equally effective in holding old clients and in gaining new ones, and advertising of this kind tends constantly to raise the standard of efficiency in the profession.

A FORM OF PETTY GRAFT

BY F. B. JACOBS*

Some months ago, I chanced to hear of a concern in the Middle West that wanted toolmakers badly enough to pay above the normal rate to obtain them, and as I was looking for work at the time, I called on the superintendent. I got there early—about fifteen minutes before starting time—and as I sat close to the time clock, I had a good opportunity to observe the class of men employed. They were of the well dressed, clean-cut type, the black shirt and week's growth of beard being conspicuous by their absence. They reminded me of the better class of toolmakers I had associated with while working in some of the large, modern tool-rooms for which the Eastern states are noted.

After the last man had rung in, and the blast of the whistle had announced the beginning of another working day, I noticed that I was not alone; another man was waiting, and as he had his kit of tools with him, I concluded that he had reported for duty. He was a communicative chap and before long we were engaged in conversation.

"On the level," I asked, "what are they paying here?"

"Well," he replied, "if you are an A-1 workman, strike the old man for fifty cents an hour and you'll get it. I know that they are hard up for toolmakers, as they had a man in Chicago looking for some. That is why I am here F. O. B. destination."

Just then the superintendent came out, and after disposing of my newly found acquaintance, he turned to me with a brusque: "What can I do for you?" I told him I was looking for a job as a toolmaker, and he then proceeded to ask me the usual questions as to experience, places of previous employment, etc., after which he asked me what rate I wanted. I told him I wanted fifty cents per hour, and after a moment's hesitation he instructed me to report for duty as soon as possible.

The tool-room was well lighted and modern in every respect, and I began to think that I had landed a *real* job. The foreman assigned me a bench, and while he was looking up some work for me, I glanced at a few blueprints that were handy. The instruction: "One of cast iron," and the familiar B. S. F. (British standard form), proved the origin of the drawings, and further investigation revealed the fact that they showed rapid-fire gun parts, notwithstanding that the title blocks in the corners had been obliterated. The foreman brought me a drawing of a jig, together with a casting for its base, and as I found a shaper vacant I was soon at work. After I had started to rough out my casting I had an opportunity to glance about the shop. I noticed two things right away. There were altogether too many men for the number of machine tools, and they spent too much time visiting.

"What kind of a game is this?" I asked a fellow toolmaker.

"We are employed on war work for the British government, as you have probably noticed from the drawings," he answered with a grin. "The firm gets $1 an hour for each man's time, and as long as the men give the appearance of working, whether they really are or not, there is no kick coming; it's a regular cinch."

After about twelve hours' work on the shaper I was ready to bore my jig and, naturally, I turned to the miller. There were some ten or twelve millers in the shop, but every one was not only in use but spoken for by at least two other toolmakers; and some of them were tied up on insignificant jobs that should have been machined in other ways. As an illustration, one man had ten pieces to machine, 2 inches square by 5/16 inch thick. He was milling them at an abnormally slow speed—"to make his job last," he confided to me, "until he could get a lathe." I next turned my attention to the lathes, as I could use one on my job. It was the same story—every one taken and spoken for as soon as idle. The foreman noticed my predicament and remarked that ten new lathes had been on order for some time, and that he expected to receive them during the coming week. He also volunteered the information that the management would, in all probability, hire twelve men to operate them, stating that this was the usual custom.

* Address: 109 W. St. Clair St., Indianapolis, Ind.

As I had a little bench work to do, I managed to keep busy for two or three days, after which I began to follow the usual methods of killing time; I had to do this to hold my job. As an illustration of what the men did to get in their time, I recall one man who spent a whole day in drilling, reaming and counterboring six small holes in a ½-inch piece of stock. The tool crib was a popular place to appear to be busy. For instance, a man would get a 19/64-inch drill, that he had absolutely no use for. He would take this to his bench, indulge in a liberal chew of tobacco, and then go back to the tool crib for a 5/16-inch reamer. Then he would take a walk about the tool-room, making a few friendly calls for the purpose of discussing politics and the war, after which he would return the unused tools and call for others.

There are many concerns in the Middle West where these tactics are followed, as I have since learned, and conditions are about the same in all places. It is harder to kill time than to work, at least I have always found this to be the case, but I stuck it out for five days and then quit in disgust. Now this is a condition of affairs that should not be allowed to exist. It is petty graft, pure and simple, and should not for an instant be countenanced by manufacturers who purport to pride themselves on their business integrity. When we take a small job to a contract shop, we expect to be over-charged as a matter of course; but for highly capitalized concerns to resort to this dishonest practice is wholly uncalled for. Is it small wonder that European countries consider our charges exorbitant and hate us accordingly?

* * *

WHAT INDUSTRIAL PREPAREDNESS MEANS

The Committee of Industrial Preparedness of the Naval Consulting Board of the United States, Howard E. Coffin, chairman, is busy on the problem of securing data from 30,000 manufacturing plants in the United States, which are to be available in a time of emergency and which will give exactly the capacity of each and the character of munition work to which each can be most readily adapted. In connection with this work, Bascom Little, president of the Cleveland Chamber of Commerce of the United States, and chairman of the National Defence Committee, in an interview gave the following illuminative statement of the experience of his concern in the manufacturing of three-inch high-explosive shells as follows:

> The thing that has stirred up the business men of the Middle West during the past eighteen months has been the lesson they have learned in the making of war materials. It points a very vivid moral to all our people. It all looked very easy when it started a year and a half ago. The plant with which I am associated in Cleveland got an order for 250,000 three-inch high-explosive shells. It was a simple enough looking job, just a question of machining. The forgings were shipped to us and we were to finish and deliver. It began to dawn on us when the forgings came that this whole order, that looked so big to us, was less than one day's supply of shells for France or England or Russia, and we felt that in eight months by turning our plant, which is a first-class machine shop, onto this job we could fill the order. In a little while we got up against the process of hardening. That—and mark what I say—was fourteen months ago. To date we have shipped and had accepted 130,000 shells, and those, about half our order, are not complete. They still have to be fitted by the fuse maker, then fitted in the brass cartridge cases with the propelling charge, and somewhere, some time, maybe, they will get on the battlefield of Europe. Up to the present none of them has arrived there.
>
> Now this is the situation in a high-class, efficient American plant. This is what happened when it turned to making munitions of war. The same thing has occurred in so many Middle Western plants that their owners have made up their minds that if they are ever going to be called upon for service to their own country they must know more about this business. They feel that they are now liabilities to the nation and not assets in case of war. Proud as we may be of our industrial perfection, it has not worked here, and the country—particularly you in the East—may as well know it.

* * *

For so-called "clash" gears, high-carbon tool steel is superior to casehardened machine steel. Gears made from the latter material are likely to have the hard case chipped off, thereby exposing the soft core to the impact of clashing.

RELATION OF PRESSURE, RAM DIAMETER AND TONNAGE IN HYDRAULIC PRESSES

BY W. B. UPDEGRAFF*

The relation of ram diameter, pressure in pounds per square inch, and total pressure in tons on the ram of a hydraulic press may be readily ascertained by using the diagram below. The vertical coordinates represent hydraulic pressures in pounds per square inch on ram; the intersecting diagonal lines represent ram diameters; and the horizontal coordinates represent total pressure on ram, in tons. Assume, for example, that there is a pressure of 8000 pounds per square inch in a hydraulic cylinder. The ram diameter is 8 inches; by following the vertical line from "8000" on the bottom scale to the diagonal line for 8 inches ram diameter, and from the intersection between these two lines following the horizontal line to the vertical scale at the side of the diagram, it is found that the total pressure on the ram is 200 tons. With any two quantities known, the third can easily be determined by reference to the diagram.

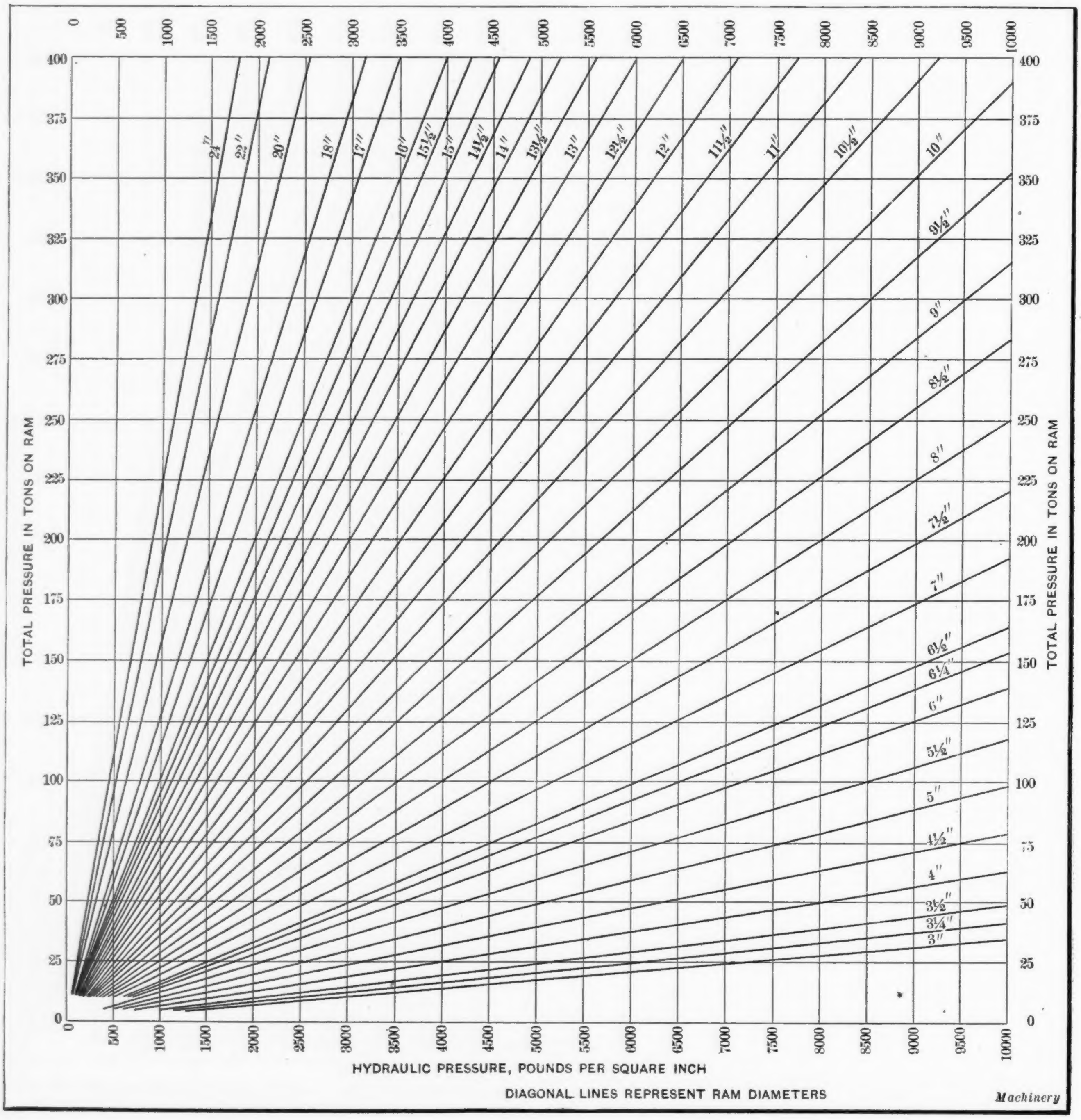


Diagram showing Relation between Ram Diameter, Hydraulic Pressure, and Total Pressure on Ram of Hydraulic Jacks and Presses

* Mechanical Engineer with the Watson-Stillman Co., New York City. Address: 522 Magie St., Elizabeth, N. J.

PLATINUM SUBSTITUTE IN LAMP MAKING

In the ordinary incandescent lamp, the platinum wire is sealed through red-hot glass. During the process of cooling, however, the platinum tends to shrink away from the glass slightly, owing to the fact that the coefficient of expansion of glass is somewhat greater than that of platinum. Since the lamp must be hermetically sealed, this is, of course, objectionable. To overcome this, the idea was conceived of making a wire with a coefficient of expansion a little less than that of the glass to which it was to be sealed so that, upon cooling, the glass would shrink down on the wire, compressing it slightly. This wire is composed of a core of nickel-steel, surrounded by a jacket of copper which is enveloped in platinum. The composition of the nickel-steel is such that its own expansion, averaged with that of copper and platinum, gives the wire, as a whole, a little less expansion than that of the glass, so that the desired compression seal can be obtained. The function of the copper in this combination is not only to give a greater electric conductivity—something much needed in these small leading-in wires—but also to make the expansion of the nickel-steel more regular.

THE DESIGN OF HYDRAULIC PRESSES*

PROPORTIONS OF CYLINDER AND RAM—CYLINDER PACKING—DESIGN OF COLUMNS AND HEAD

BY HUGO FRIEDMANN†

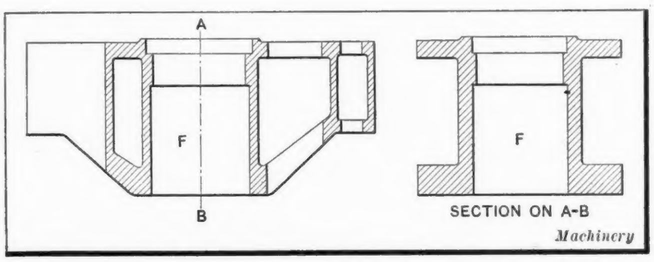


Fig. 1. Bed Casting designed with Hole F to receive Cylinder

HYDRAULIC presses have certain advantages as compared with plain mechanical presses. They are easily attended, noiseless and not subject to excessive wear; and they furnish heavy pressure without shock. On the other hand, their speed is lower than that of the mechanical press, and consequently their rate of production is not as great. Hydraulic presses, however, are ideal for many classes of work. There are baling presses for hay, cotton and rubbish; filter presses for the chemical industries; smoothing presses for paper mills; oil and seed presses; forging presses, hydraulic shears, punches, riveters, bending machines, drawing benches and extrusion machines for metal working; and hoists and elevators. The capacities range from a few hundred pounds up to 15,000 tons. Current practice in the design of hydraulic presses varies widely according to the different classes of work to be handled. In general, however, the main parts are the same and constitute the essential elements of every special machine of this class.

The Elements

The plain hydraulic press shown in Fig. 2 consists of the cylinder A, plunger or ram B, press plate C, columns D, and head or beam E. Sometimes the cylinder is a plain round body without lugs for the columns; and such cylinders are inserted into the center hole F of a separate bed as shown in Fig. 1. Another variation occurs when the press plate is required to be of excessive size, but is only intended for a low unit pressure; in this case both bed and head are made of structural steel, and a counterplate G is added, such a design being shown in Fig. 3. Otherwise these parts, as well as the cylinder and press plate, are made of cast iron or cast steel. For very heavy machines, forged steel cylinders are used. Sometimes it is necessary to make the ram of bronze, and to avoid leakage caused by flaws in the casting, the cylinders may be lined with sheet copper. Fine pores in the metal are easily closed by applying silicate of potassium.

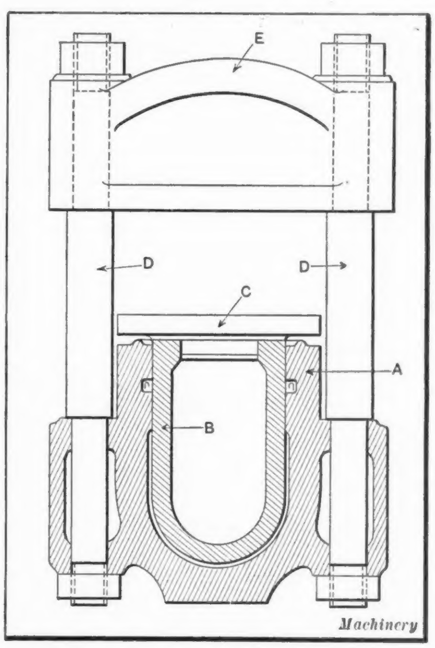


Fig. 2. Elements of Hydraulic Press

The Cylinder and Ram

In laying out a new hydraulic press, it is necessary to first decide upon the full load, length of stroke, width between press plate and head, and size of press plate to suit the work for which the press is to be used. The next step is to determine the diameter of the ram, which may be read directly from the diagram Fig. 4, or calculated by using Formula (1):

$$D=\sqrt{\frac{4L}{\pi P}} \qquad (1)$$

where L = full load;

P = working pressure of fluid in pounds per square inch.

Before using either method, one must assume the value of the unit pressure P, which may vary from about 100 to 7000 pounds per square inch. This range covers extreme conditions; but even for common medium sized presses the limits are wide, ranging from 1500 to 3500 pounds per square inch. In selecting the best value for each individual case, various conditions have to be considered, such as the available pumps and piping, the degree of care and attendance that may be required, and the general proportions of the design. These proportions usually make it necessary to increase the pressure in relation to the load. The size of the press plate, which is fixed by the special duty required of the machine, has some influence. The diameter of the ram should not exceed the height, nor should it be a great deal smaller if such a condition can possibly be avoided. Finally, a reasonable proportion should exist between the length of stroke and diameter of ram. A good method is to prepare a table of three or four sets of figures for diameters and corresponding values of pressure. The diagram presented in Fig. 4 is especially convenient for this purpose, making it easy to decide which lay-out comes nearest to meeting all the conditions referred to.

The next step is to consider the length of the cylinder. It is obvious that it must be nearly equal to the sum of the full stroke plus the length of the slideway and stuffing-box. The length of the slideway depends to some extent upon the arrangement of the press plate. If the plate is small or has reliable guides for itself, as in the case of a forging press, the slideway in the cylinder may be short, for there is no danger of getting eccentric loads upon the plunger. But the more the machine is exposed to eccentric pressure, the more attention must be given to the design of the slideway. That means that this question must be carefully studied in every case. The worst possible condition arises when the load W acts at some distance a from the center, so that the ram is forced against side A on the upper and side B on the lower end of the slideway, the condition being shown in Fig. 5. The pressure Q set up at points A and B is given by the following equation:

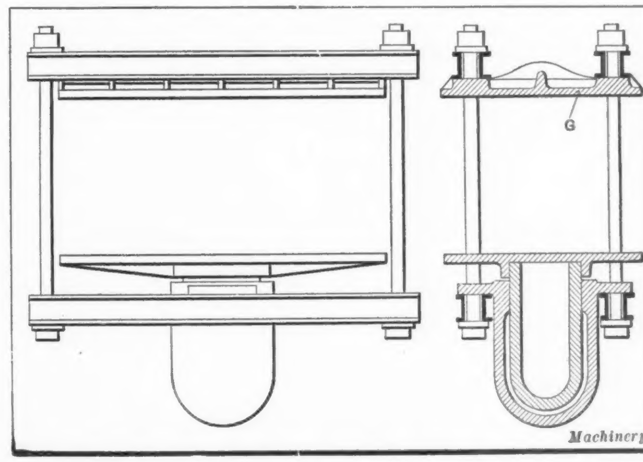


Fig. 3. Construction employed when Press Plate is unusually Large

* For other articles on the subject of hydraulic press design and allied subjects published in MACHINERY, see also "New Design of Hydraulic Cylinder Glands," July, 1910; "Design of Hydraulic Accumulator," December, 1911; "Improved Design of Hydraulic Accumulator," March, 1912; and "Design of Hydraulic Intensifier," September, 1912.

† Address: 5484 Kenwood Ave., Chicago, Ill.

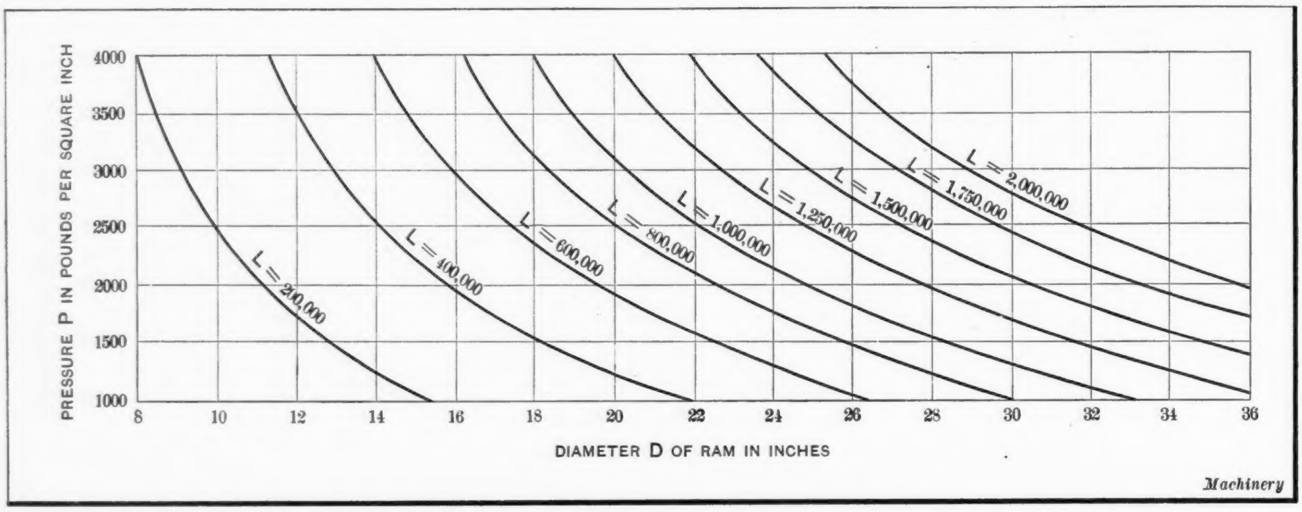


Fig. 4. Diagram showing Relation between Pressure per Square Inch on Ram, Diameter of Ram and Full Load Capacity of Press

$$Q = \frac{Wa}{b} \qquad (2)$$

To keep pressure Q within safe limits, the value of b must be increased as required. The value of b depends on both the length of the slideway and the diameter, so the length need not always be increased when the diameter is increased.

The Thickness of Cylinder and Ram

The required thickness of the cylinder may be determined by one of the following formulas:

$$T = R\left(\sqrt{\frac{H+P}{H-P}} - 1\right) \qquad (3)$$

$$T = R\left(\sqrt{\frac{H+0.4P}{H-1.3P}} - 1\right) \qquad (4)$$

where T = thickness of cylinder wall;
H = safe hoop stress of metal;
P = unit working pressure of fluid in pounds per square inch;
R = inner radius of cylinder.

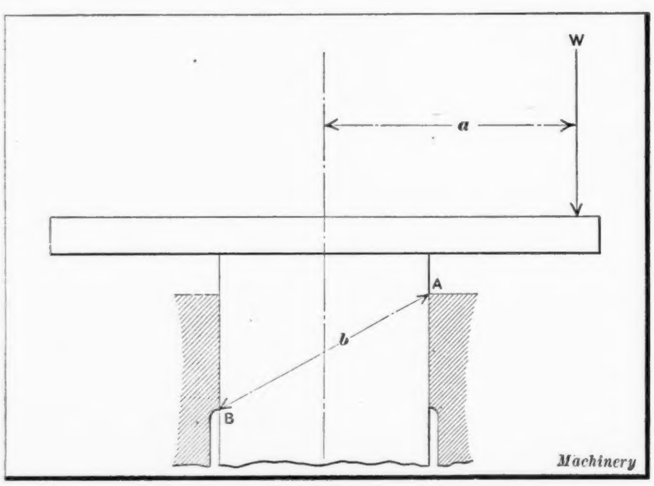


Fig. 5. Condition that exists when Eccentric Load is applied to Press Plate

Formula 3 (Lamé), which is generally used in this country, has been developed in a theoretical way; Formula 4 (Bach), generally accepted in Germany, has been derived by experiment. They give nearly the same results if the value of P is only a small part of H; for instance, when $H = 7000$ pounds per square inch and $P = 1500$ pounds per square inch. For higher values of P, Formula (4) indicates thicker walls than Formula (3), and as a result limits the use of high pressures sooner, in accordance with practical experience. Both formulas are only valid for internal pressure, and cannot be applied in designing the ram which is exposed to external pressure. For this case there is only one formula (Bach), which is as follows:

$$T = \frac{D}{2}\left(1 - \sqrt{\frac{C-1.7P}{C}}\right) \qquad (5)$$

where C = safe compressive stress of metal;
D = diameter of ram.

The allowable stresses in parts of hydraulic presses are much higher than for other classes of machines, partly on account of the absence of shock. The following values are only to be used with the preceding formula. For cast iron the safe tensile stress may be assumed to be between 4000 and 7500 pounds per square inch; and the safe compressive stress between 14,000 and 19,000 pounds per square inch. The upper limits, of course, assume first-class material and foundry work. For cast steel, the corresponding figures are: 15,000 to 18,000 pounds per square inch for tension, and up to 22,000 pounds per square inch for compression.

In order to avoid the necessity of making repeated calculations, diagrams Figs. 6 and 7, have been developed, which represent the thickness of the cylinder and ram, according to

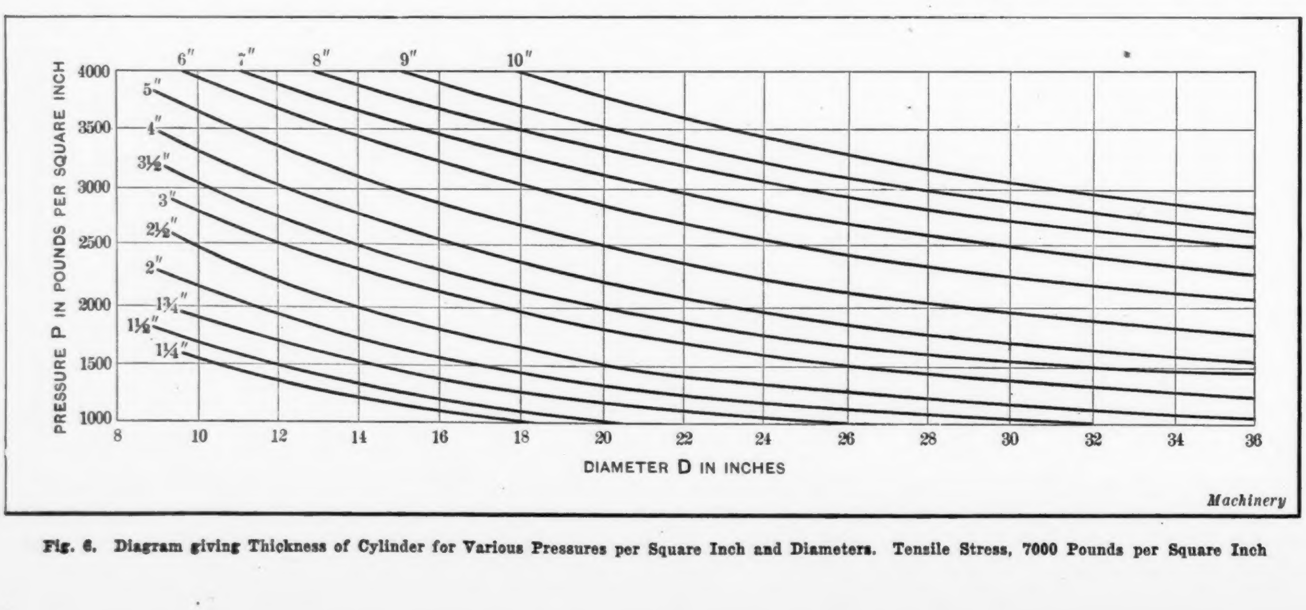


Fig. 6. Diagram giving Thickness of Cylinder for Various Pressures per Square Inch and Diameters. Tensile Stress, 7000 Pounds per Square Inch

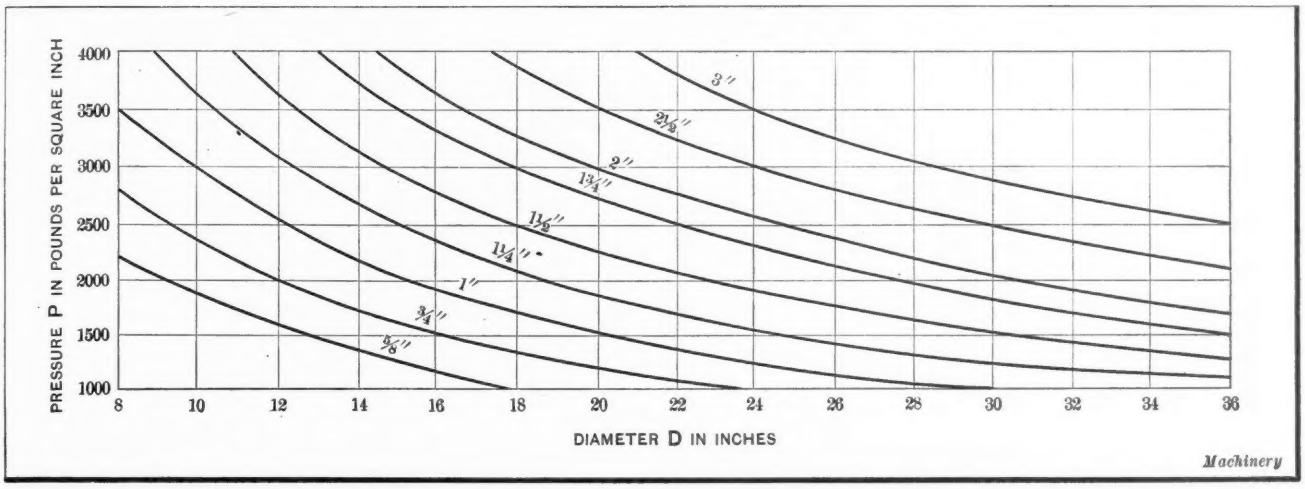


Fig. 7. Diagram giving Thickness of Ram for Various Pressures per Square Inch and Diameters. Compressive Stress, 14,000 Pounds per Square Inch

Formulas (4) and (5), for common sizes of machines and working pressures. They are based on unit working stresses of 7000 pounds per square inch for tension and 14,000 pounds per square inch for compression. For other conditions, similar diagrams may be easily developed.

Formulas (4) and (5) relate strictly to the cylindrical parts of the castings, but a plunger with a hemispherical bottom, as shown in Fig. 2, has greater strength than a tube and therefore requires less thickness. It is a practical foundry rule, however, to make the bottom at least as thick as the cylindrical part, and often even thicker, making an allowance for the shifting of the core and the introducing of the boring rod through a hole. These bottoms are, of course, very heavy. The form of plunger shown in Fig. 8 is a more economical form; it requires a good deal less material and is still safe.

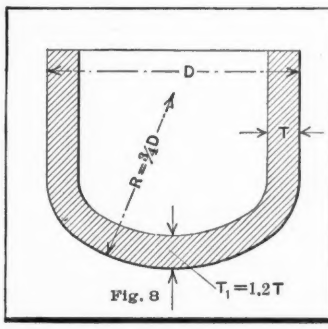


Fig. 8. Good Form of Hydraulic Press Plunger

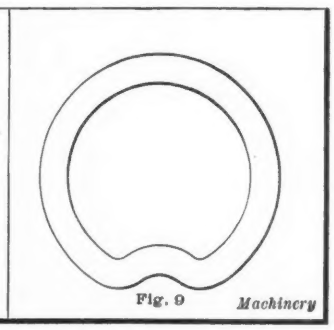


Fig. 9. Packing Ring bent ready to be put in Place

The Packing

The best packing for the plunger is a U-shaped leather ring. It is self-acting and avoids needless friction, for its pressure against the ram starts and increases with the actual working pressure of the liquid. A tight hemp packing does not offer that advantage, because it produces full pressure continuously and high friction. For small cylinders a removable gland is necessary for introducing the leather ring, but it may be omitted from cylinders of 10 inches diameter and upward. It is often claimed that the application of a packing without a gland does not prove satisfactory, but when bad results are experienced, they are generally caused by careless manipulation.

The writer remembers one case where—when the press was first shown to him—the operators actually had to renew the packing every week, losing four or five hours each time. The custom was to soak the new ring in cold water for several hours, and introduce it in the usual way by first bending it to the shape shown in Fig. 9 and then driving it into the groove with a wooden mallet. In order to improve conditions, the operators of this press were taught to prepare the ring by dipping it into hot grease immediately before inserting it. This treatment makes the leather very soft, and in this particular case made the packing last four weeks instead of one. Later, the cast-iron ram was exchanged for a bronze one, on account of the fact that the water used in the plant contained traces of acid which destroyed the surface of the iron ram within a short time. The resulting roughness of surface naturally increased the friction and consequently the wearing of the leather ring; but the bronze resisted the action of the acid so that the surface was kept smooth, and the life of the packing was prolonged to fourteen months. Before these expedients had been tried, the whole blame for the trouble was laid upon the failure of the designer to provide a gland; but the results of the change in the method of applying the packing and the substitution of a bronze ram made it evident that the provision of a gland would not have been a real help.

The Columns

Hydraulic presses are usually built with either two or four columns. Although four columns are naturally preferable for heavy machines, there is sometimes no space for more than two; for instance, when the material has to be fed by a revolving table turning around one of the columns. Presses with a horizontal axis are often built with three columns, because this arrangement makes all parts readily accessible. The allowable tensile stress in the columns may be high on account of the absence of shock. For small and medium lengths, columns such as shown in Fig. 2 are cheaper than

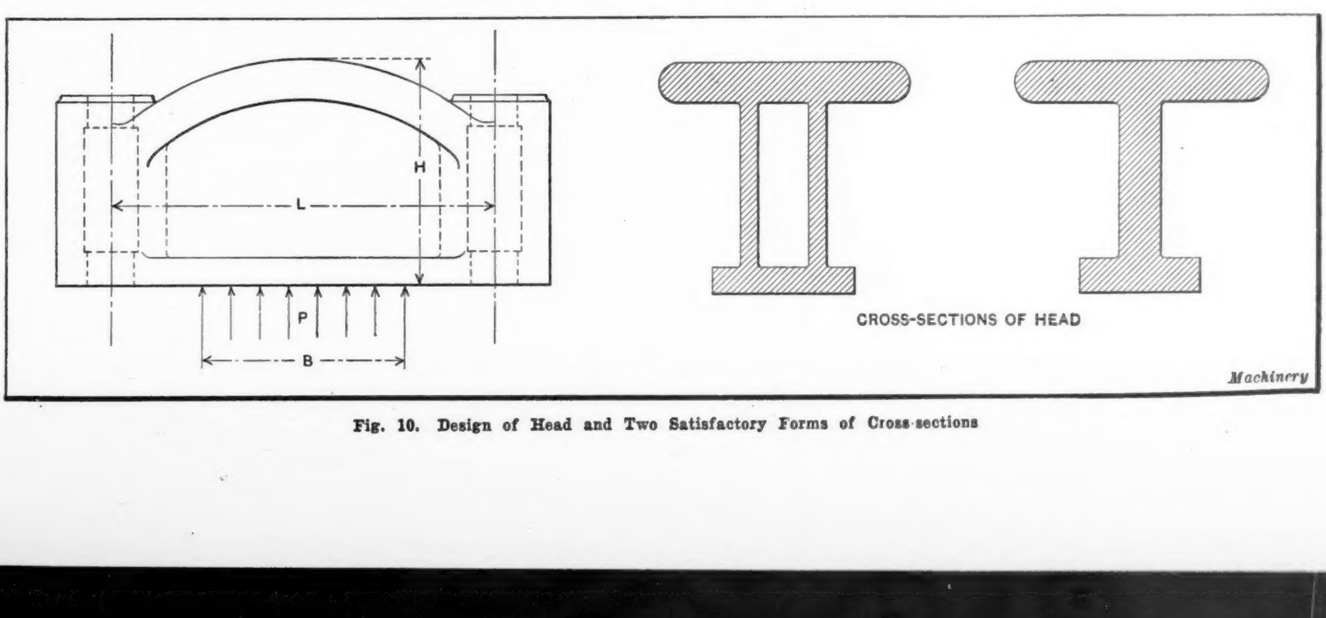


Fig. 10. Design of Head and Two Satisfactory Forms of Cross-sections

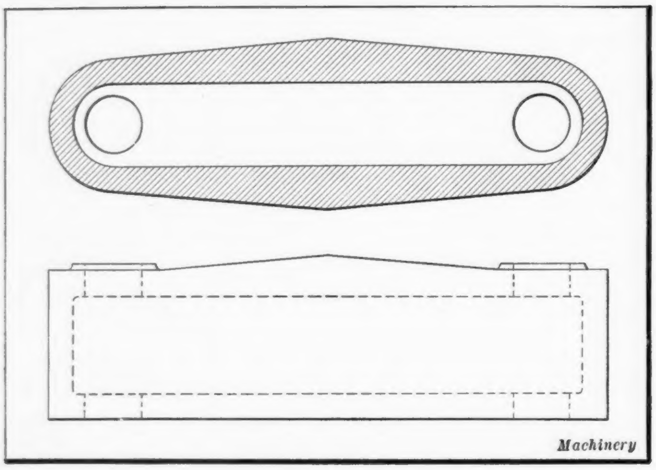


Fig. 11. Attempt made to strengthen Dangerous Section of Head by increasing Thickness of Web

columns of smaller diameter with forged collars. A shoulder ¼ inch in height is sufficient even for large machines.

The Head

The design of the head varies according to the size of the press plate, the space between the columns and the amount of the load. The head is required to perform two functions: first, that of a beam exposed to a bending load and supported by columns; second, that of a counterplate for the pressed work, corresponding to the press plate. If the plate is comparatively small, the type shown in Fig. 10, with either of the forms of cross-sections shown, will be found to give satisfactory results. This shape is especially adapted to the peculiar difference between the tensile and compressive strength of cast iron (proportion about 1 to 3). As the upper part is exposed to tension, it is made much stronger than the base, which supports the compressive stress. The dimensions cannot be determined by the usual method of figuring beams, because it assumes a uniform bending stress for the whole section and is good only for materials that have equal strength for both tension and compression. The correct way of calculating the required cross-section of cast-iron beams, as described in the following, takes a little more time but is not complicated and possesses the advantage of giving perfectly reliable and most economical results.

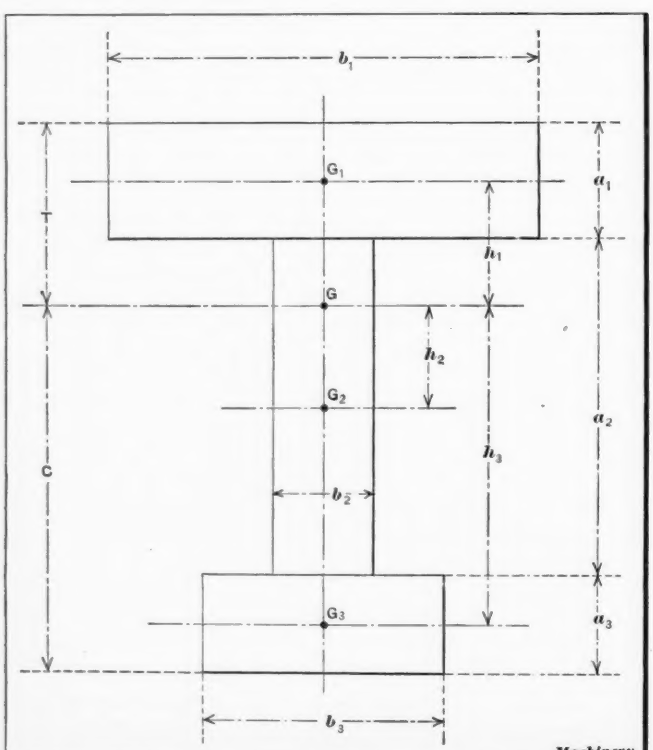


Fig. 12. Method of determining Moment of Inertia of Cross-section of Head

It is most practical to start by assuming the height of the middle section and reasonable outlines for the elevation; and they may be varied afterward, if necessary. Then the dangerous cross-section must be laid out according to either of the suggested cross-sections in Fig. 10. The design begins with the base part which depends upon the size of the press plate or counterplate. Concerning the vertical walls, it has to be remembered that they do not add much to the strength of the beam, although they add greatly to its weight. It is therefore economical to keep them as thin as possible, although the limitations of foundry work do not allow of decreasing them to the same extent as the webs of rolled steel sections. The design of head shown in Fig. 11, where an attempt has been made to strengthen the dangerous section by increasing the thickness of the web, represents very poor practice and clearly illustrates the advantage of the types of cross-sections shown in Fig. 10, which add the material where it is most efficient, by making the upper flange broader and thicker.

When a complete section is laid out according to these considerations, its moment of inertia has to be determined to prove its fitness for the required service. For this purpose the section is reduced to three rectangular parts, as shown in Fig. 12, which are equal in area to the main parts of the lay-

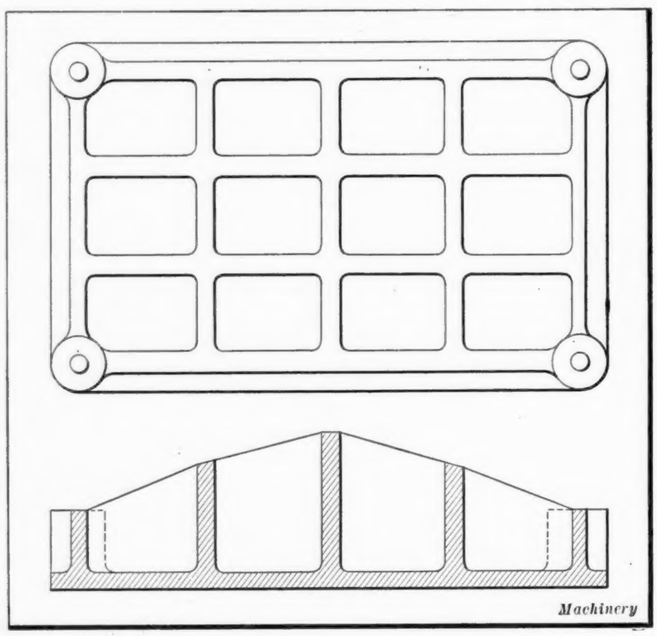


Fig. 13. Design of Head for Use on Press with Large Press Plate

out. The center of gravity G of the whole area may be determined either by a graphical method or by Formula (6):

$$G = \frac{A_1\left(\frac{a_1}{2} + a_2 + a_3\right) + A_2\left(\frac{a_2}{2} + a_3\right) + A_3\frac{a_3}{2}}{A} \qquad (6)$$

where A = area of the complete section;

$A_1 A_2 A_3$ = areas of the rectangular parts.

The moment of inertia I for the whole section may be calculated by Formulas (7) to (10):

$$I_1 = a_1 b_1^3 + a_1 b_1 h_1^2 \qquad (7)$$
$$I_2 = a_2 b_2^3 + a_2 b_2 h_2^2 \qquad (8)$$
$$I_3 = a_3 b_3^3 + a_3 b_3 h_3^2 \qquad (9)$$
$$I = I_1 + I_2 + I_3 \qquad (10)$$

Usually several parts of these formulas may be neglected because they are of little consequence. Finally the section moduli for the lay-out are:

For tension:

$$R_t = \frac{I}{T} \qquad (11)$$

For compression:

$$R_c = \frac{I}{C} \qquad (12$$

where T and C = distances of outer fibers from center of gravity of sections.

On the other hand, the actual bending moment M is:

$$M = \frac{W}{4}\left(L - \frac{B}{2}\right) \qquad (13)$$

Therefore, the section moduli required for the machine are:
For tension:

$$R_t = \frac{M}{t} \qquad (11a)$$

For compression:

$$R_c = \frac{M}{c} \qquad (12a)$$

where t = safe tension stress;
c = safe compression stress.

Of course, at the first attempt, there will be a difference between the actual and the required moduli. Then the dimensions have to be changed and the new section checked up by repeating the calculation. The design will be satisfactory when the results obtained from Formulas (11) and (12) nearly equal those obtained from Formulas (11a) and (12a). The following stresses may be allowed: For cast iron: tensile stress, up to 3500 pounds per square inch; compressive stress, up to 8000 pounds per square inch; for cast steel: tensile stress, up to 6000 pounds per square inch; compressive stress, up to 9000 pounds per square inch.

After determining the dangerous cross-section, the design of the head is completed by lowering the height toward both ends, and also decreasing the width, if the location of the columns makes it possible to do so. The section near the columns must be checked up to make sure that it has the necessary shearing strength.

Quite a different problem arises when the press plate is very large. In this case, the full load is usually not very high and the pressure per square inch of the pressed work is quite low. The head, Fig. 13, is not of the I-beam type; the best practice is to make it a plain plate stiffened with ribs. Its chief duty is as a counterplate, and allows no chance for an equal distribution of the stress. Most of the material is necessarily accumulated in the lower compressed part and much less in the tensile fibers. Heads of this type are designed by dividing them in strips of equal width on both sides of each rib and determining the stress of each part according to its share of the load. First, a sketch is laid out and dimensions assumed, then the figuring is done, and finally the dimensions are changed until they meet the required condition. The construction shown in Fig. 3, which employs a cast-iron counterplate and steel channels, is a logical result of the foregoing considerations. It transmits the full bending moment to the rolled steel sections, which are especially fit for that duty, and only exposes the casting to small local loads. The required dimensions of the counterplate may be determined in the same way as for the head.

* * *

The ability to be rated as a first-class man is only acquired by constant attention to work, and by always being on the lookout for information.

MACHINE FOR CUTTING POWDER TRAIN GROOVE

BY DONALD BAKER*

The difficulty of obtaining a standard machine adapted for cutting the powder train groove in time fuse rings led us to design the special machine described in the following article. Owing to the small size of the cutter used for this purpose, it is necessary for the machine to operate at a very high speed, and as an exceptionally smooth finish is required for the work to pass inspection, it is also imperative for the machine to be absolutely rigid. These were the requirements which we were called upon to fulfill in designing a special machine for doing the work. Fig. 1 shows one of the time fuse rings, in which the powder train groove is shown at A. Before coming to the machine, this groove has been roughed out on a machine equipped with a circular cutter instead of an end-mill, and this cutter leaves 0.005 inch on the sides and bottom of the groove which has to be removed by the finishing machine; also there is considerable stock left at each end of the groove, as it is obviously impossible for a circular cutter to work right up to the end of the groove and produce the required semi-circular form.

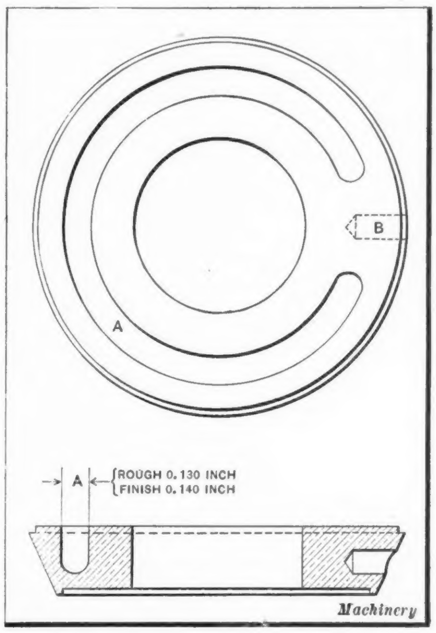


Fig. 1. Time Fuse Ring in which it is required to cut Powder Groove A

The machines originally purchased for doing this work were a modification of a high-speed drilling machine, and were equipped with a table similar to that of a milling machine with an auxiliary rotating table on which the work was held by a locating and clamping device operated by a foot-treadle. These machines were designed to run at about 8000 revolutions per minute, and they were made with so much overhang, and so many gibs and slides, that sufficient vibration was set up to produce chatter marks on the work. In designing our special machines we eliminated all gibs, and the overhang of all working parts was reduced to a minimum. Referring to Fig. 2, which shows the machine, it will be seen that headstock A is cast integral with the base; and at the outer end of the main spindle B there is a faceplate C provided with a locating pin D which enters hole B, Fig. 1, in the work. The spindle is hollow, and the outer end which projects beyond the faceplate is ground to a taper that acts in conjunction with the auxiliary draw-in spindle shown in Fig. 3 to form an expanding work-holding device that automatically adjusts itself to the high and low limits of the bore in the time fuse rings, and provides for holding the work back against the faceplate; at the same time, locating pin D prevents the ring from turning while the milling operation is being performed. The draw-in spindle can be operated by either a hand-lever or a foot-treadle.

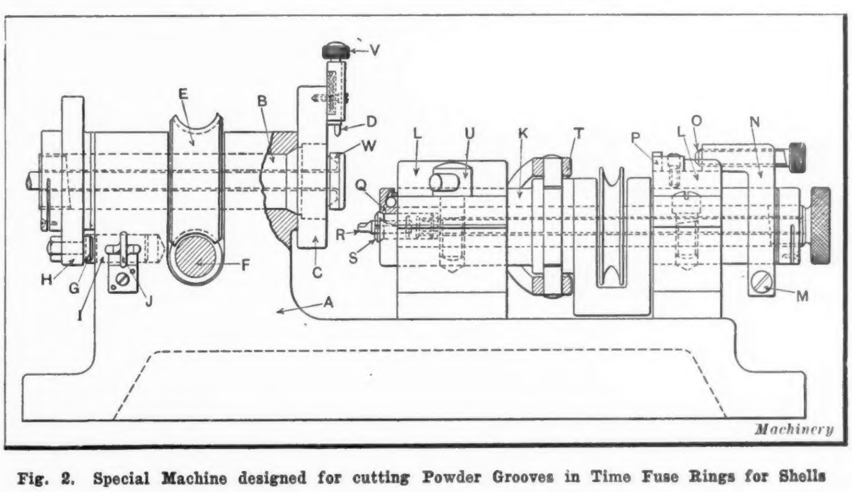


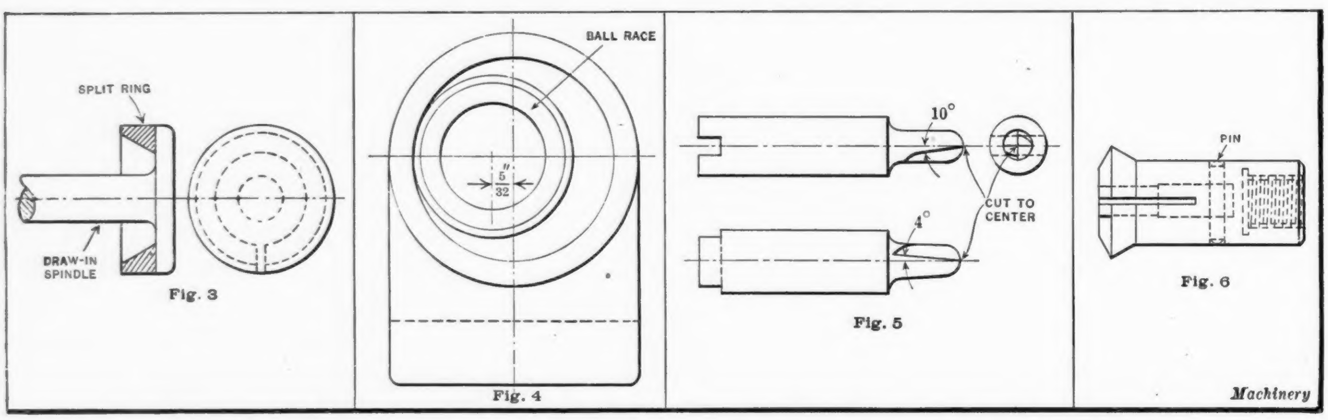
Fig. 2. Special Machine designed for cutting Powder Grooves in Time Fuse Rings for Shells

To provide for rotating the work-spindle, a worm-wheel E is mounted on the spindle; this meshes with worm F carried by a shaft, at the outer end of which there is a pulley driven by a round leather belt. This belt is not very tight and is in-

* Address: 41 Grant Ave., Jersey City, N. J.

tended to slip when the adjustable stop G is engaged; stop G is carried on a plate with a circular T-slot in which it is secured in the desired position. The plate is mounted on the work-spindle, as shown at H, and stop G strikes pin I when the work has been fed around to the desired position. In addition to the stop which determines the end of the groove in the ring, there is a second stop G which is brought into contact with pin I to locate the work in the starting position.

The opposite end of the machine, which carries the cutter-spindle, must have a considerable range of adjustment to provide for the different sizes of rings which have to be machined; but in designing the machine the use of slides and gibs was done away with, owing to the tendency of this form of construction to introduce trouble caused by lost motion. To accomplish the required result, spindle bearing K was made in the form of an eccentric bushing (shown in detail in Fig. 4) which was supported and guided at the ends by two cast-iron bearings L. To change the position of the cutter to provide for cutting slots of any required radius of curvature, it is merely necessary to revolve the eccentric bearing to either the left or right and then secure it in the desired position by tightening screw M which actuates clamp N; this clamp is similar in shape to a lathe dog, and the tail slides in a groove of the bearing cap, the adjusting screw O being set to strike against stop P to adjust the cutter for working to the required depth. The spindle which carries cutter R and draw-in chuck S (shown in Figs. 5 and 6, respectively) is operated by hand-lever T, and when the cutter is operating on the work, the longitudinal position of the spindle is maintained by tightening bolt U which draws the split spindle bearing together. When the work is finished, this bolt is loosened to allow the cutter to be drawn back out of the work by operating hand-lever T.



Figs. 3 to 6. Expanding Arbor, Adjustable Cutter-spindle Bearing, Cutter, and Draw-in Collet for holding Cutter

In operating the machine, locating pin D is withdrawn from the work by knurled knob V and a fresh blank put in position on the expanding arbor. Knob V is then released so that the spring may force pin D into position in the hole in the work, after which the draw-in spindle is pulled back to secure the work in position on expanding arbor W. To secure the maximum production, this work-holding device should be operated by a foot-treadle. After the work has been set up, the proper starting position is determined by bringing starting stop G into contact with pin I. The cutter is then brought forward by hand-lever T and clamped in the proper position, after which the work-spindle feed is started and the work revolved against the cutter until the second stop G strikes pin I, showing that the cutting of the groove has been completed. Then the cutter is drawn back ready for the work to be removed.

* * *

The following is a receipt for casehardening, which can be used in cases when a hard exterior with a soft and tough interior is desired on steel of grades ranging up to about 0.20 per cent carbon. First, carbonize in any suitable casehardening compound at 1650 degrees F. and then plunge in water; reheat to 1425 degrees F. and plunge in thin, cool oil. The process refines the grain and gives the core a maximum of toughness. This receipt has been used with success by the Pratt & Whitney Co.

IMPORTANCE OF FOUNDATIONS UNDER MACHINE TOOLS

Everyone knows that machinery, in general, operates better when mounted on a solid foundation than when supported by a springy floor, but very few comparative tests have been made to demonstrate the actual increase in efficiency due to a firm foundation. A correspondent of *Grits and Grinds*, published by the Norton Co. and the Norton Grinding Co., gives some results of comparative tests made with Norton wheels and machines, mounted on concrete foundations and on weak wooden foundations, as follows:

Average life of two wheels in No. 1 grinding room—wood floor—113 days per wheel—approximately 3.8 months.

Average life of two wheels in No. 2 grinding room—concrete floor—188 days per wheel—approximately 6.3 months.

Total increase in life per wheel due to solid foundations—75 days—approximately 2.5 months.

Average cost per wheel	$19.00
Average cost per month, per wheel on wood floor.	5.00
Average cost per month, per wheel on concrete floor	3.00
Average saving per month, per wheel on concrete floor	2.00
Average saving per year, per wheel on concrete floor	24.00
Boiler Shop—three wheels on weak foundations—Machines Nos. 1119 and 1189—approximate saving per year	72.00
Tool Shed No. 1—two wheels on weak foundation—Machine No. 20628—approximate saving per year.	48.00
Tool Shed No. 2—one wheel on weak foundation—Machine No. 20716—approximate saving per year.	24.00
No. 1 Grinding Room—seven wheels on weak foundations—Machines Nos. 14209, 14210, 14211, 14212 and 14213—approximate saving per year	168.00

* * *

The effect of the war on many industries has been to force them to experiment in order to produce native substitutes for substances that had formerly been imported. The graphite crucible business has been particularly handicapped by the lack of raw materials. An embargo was declared on Ceylon plumbago, which, although it was lifted after a few months, left the market in a depleted condition. The result was a great advance in prices. Following this, the foreign clay which is used in crucible making as a binder was exhausted. This clay, it is said, has been obtained, as far back as crucible history in this country goes, from the little principality of Klingenburg in the Black Forest of Southern Germany, where the entire government expenses are paid out of the export duty collected from the clays. None of this clay has been shipped since the beginning of 1915. It therefore devolved upon American manufacturers to produce satisfactory crucibles from American clays. Thousands of chemical laboratory and practical foundry tests were made with this object in view, and it is claimed that the crucibles produced through this experimentation with American clays have stood a surprisingly long time in the fires. The advance in prices of crucibles is due to the unusually high price of Ceylon plumbago, but it is thought that as soon as the war insurances are a thing of the past, plumbago will reach a normal figure once more and crucibles will again be marketed at as low or lower prices than they have been for many years.

WELDING HIGH-SPEED STEEL ELECTRICALLY*

THE APPLICATION OF BUTT-WELDING AND SPOT-WELDING METHODS FOR SAVING TOOL STEEL

BY FRANK WARREN†

THE welding of high-speed steel or high-carbon steel to the same kind of stock or to low-carbon steel can be accomplished by the electric welding process as easily as the welding of any other kind of metal. The only difference is in the handling of the material after the weld is made. When butt-welding two pieces of iron or low-grade steel of the same kind, a perfect and homogeneous weld can be made without any subsequent operations. But when welding high-speed or high-carbon steel, it is necessary to overcome the stresses set up at the junction of the two pieces of metal by holding the heat in the pieces until they are of a uniform temperature. This heat-treatment relieves the tension caused by the unequal expansion and contraction of the metals. It is necessary to apply the same treatment when welding dissimilar metals, like high-speed steel and low-grade carbon steel.

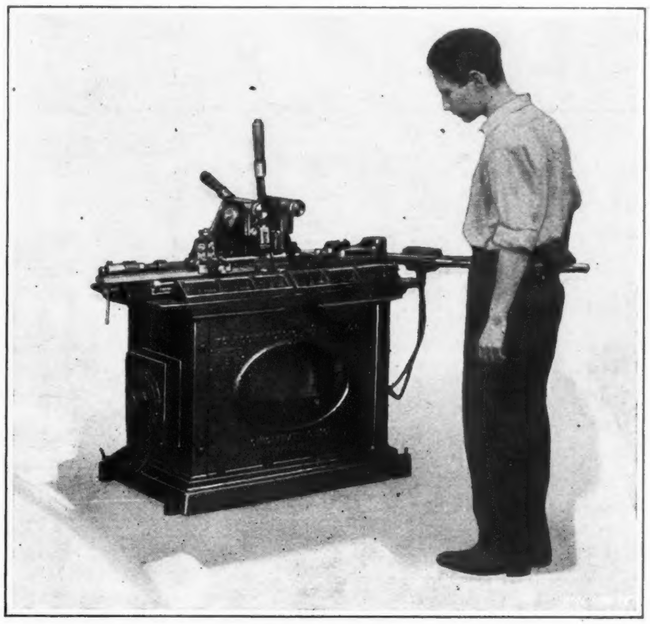


Fig. 1. Toledo Butt-welding Machine used for welding High-speed Steel or High-carbon Steel to a Shank of Low-carbon Stock. The Current Cost, at Three Cents per Kilowatt-hour, should not exceed $1.50 for 1000 Pieces of ¾-inch Square Steel which can be welded in a Day

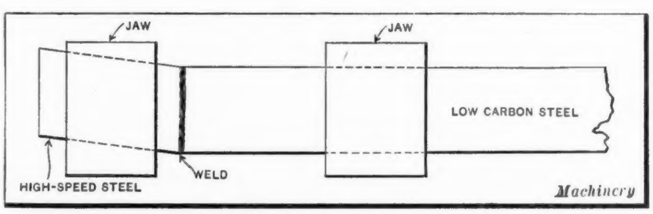


Fig. 2. Showing the Proper Relation of High-speed Steel and Low-carbon Steel Stock in the Welder Jaws

When this is done properly, the two pieces are united so that a lathe tool made in this manner can be forged, annealed and retempered, the same as though it were a solid piece of high-speed steel. Fig. 1 shows the operation of an electric butt-welding machine. The stock is clamped in the vise-like jaws, the current is turned on, and the pieces instantly begin to heat. In a few seconds, they have attained the welding temperature and a pull on the lever handle forces the abutting pieces together. When welding two pieces of stock of the

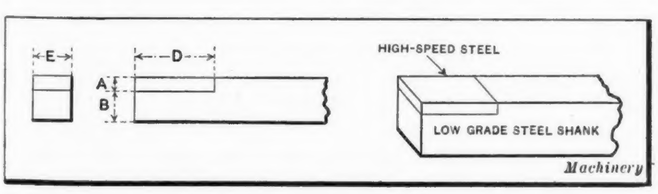


Fig. 3. Fitting High-speed Steel Pieces to Low-carbon Steel Shanks

same kind, the pieces extend an equal distance from the clamping jaws, but when welding high-speed or high-carbon stock to low-grade stock, the high-speed or high-carbon stock, being finer grained and offering more resistance to the flow of current, will heat more rapidly than the common stock. To overcome this, the stock should be placed in the jaws of the machine with the low-carbon stock extending out farther from the dies than the high-speed steel stock, as shown in Fig. 2. The difference depends somewhat on the diameter of the stock to be welded, but it should be approximately one-third high-speed to two-thirds low-grade stock. The proportions can be quickly determined, however, by watching the heat as it comes up. When both pieces heat equally, it will be known that they are placed just right. The amount of metal taken up in the weld will be approximately one-half the diameter of the stock. For example, in welding a one-inch bar of stock, one-half inch will be taken up in forcing the parts together—one-quarter inch on each side.

Butt-welding is the ideal method of utilizing high-speed steel, as stub ends can be welded to a cheap grade of carbon stock and used up. When the high-speed steel is entirely used up, the same shank may have another piece of high-speed steel welded to it. It is not necessary to saw or forge the high-speed steel to shape, as is required when preparing the stock for the spot-welding method as shown in Fig. 3. No welding compound is used, heat and pressure only being required.

After the weld is made, the stock must be immediately placed in a furnace for heat-treatment. Stresses are set up that will cause the high-speed steel to check or crack if it

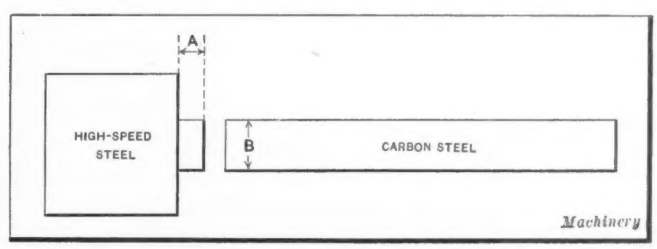


Fig. 4. Showing Reduction Necessary on Large Piece before it can be welded to a Small Diameter Shank

is allowed to drop in temperature to any appreciable extent after the weld is made. The parts are heated only at the junction of the two pieces as shown in Fig. 2, and when taken from the machine the heat radiates rapidly and unequally in the high-speed and carbon stock. This condition can be entirely overcome by proper heat-treatment. The welded pieces should be allowed to remain in the furnace for several

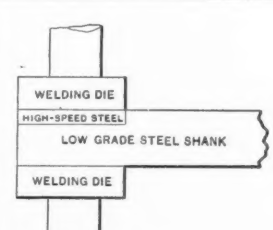


Fig. 5

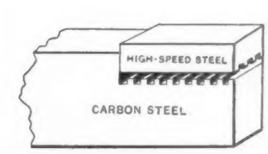


Fig. 6 Machinery

Fig. 5. Position of Parts to be welded relative to Welding Dies

Fig. 6. Grooving High-speed Steel Bit and Carbon Steel Shank for welding

* For previous articles on electric welding, see "Electric Butt-Welding Practice—1," March, 1915, and "Electric Butt-Welding Practice—2," April, 1915, and other articles there referred to.

† Secretary and general manager of the Toledo Electric Welder Co., Cincinnati, Ohio.

hours and should be cooled very slowly in order to anneal them thoroughly. After annealing, they may be reheated, forged and tempered, the same as solid stock. This process is being used by drill manufacturers and makers of tools of different kinds that require high-speed or high-carbon steel to be welded to low-grade carbon stock.

Tools of various kinds may be welded, but the work in nearly all cases should be done in the rough blanks. When welding a large diameter to a small diameter, the larger diameter must be reduced to the diameter of the piece it is to be welded to, as shown at A in Fig. 4. The length of the reduced section should be one-half the diameter of B. In making the upset, allow one-quarter of diameter B and the same amount at A. For example, if B is one inch, one-half inch should be allowed for the upset. A taper reamer can be welded when broken in the shank, but a twist drill cannot be welded if broken at the ends of the flutes, owing to the difference in cross-section of the metal in the two parts.

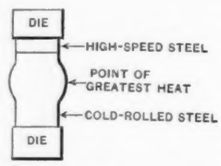


Fig. 7

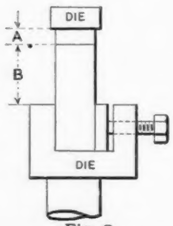


Fig. 8

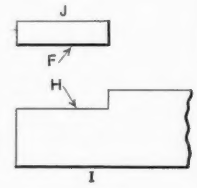


Fig. 9

Machinery

Fig. 7. Result of Improper Proportioning of High-speed and Low-carbon Steel

Fig. 8. Die for equalizing Heating Effect of Disproportioned Steel Stocks

Fig. 9. Surfaces to be welded that must be freed of Rust, Scale and Oil

TABLE I. BUTT-WELDER DATA

Area in Square Inches	K. W. Required	Time in Seconds to Make Weld	Cost per 1000 Welds at 1 Cent per K. W. Hour
0.05	2	3	0.02
0.11	3.5	5	0.05
0.20	5	5	0.07
0.31	7.5	10	0.21
0.44	12	15	0.50
0.60	15	18	0.75
0.79	18	20	1.00
0.99	25	25	1.73
1.23	35	30	2.90
1.77	50	40	5.55
2.41	65	45	8.12
3.14	75	50	10.42

Machinery

When it is desired to save small pieces of high-speed steel, a spot-welding machine may be used instead of a butt-welding machine. When the spot-welding method is used, the steel is shaped as shown in Fig. 3. The welds are made between two flat dies in either a spot-welding or a butt-welding machine, as shown in Fig. 5. If the stock is grooved, as shown in Fig. 6, it is easier to weld the flat surfaces. Any manufacturer can quickly determine whether the extra work of milling the pieces would prove profitable for his particular requirements or not. When welding small pieces of high-speed steel to low-carbon steel stock, the best results are obtained when dimension A in Fig. 3 is one-third and dimension B two-thirds of the total thickness. This proportion causes the greatest heat to be generated at the junction of the two pieces. If dimension B is made proportionately larger the hottest point will be below the junction of the pieces, resulting in the upsetting or blowing out of the stock, as shown in Fig. 7. If it is necessary to have B greater than the proportion given, a special copper die can be used which will clamp the low-grade stock as shown in Fig. 8. When this is done, dimension B is kept in the proper relation to the thickness of the high-speed steel.

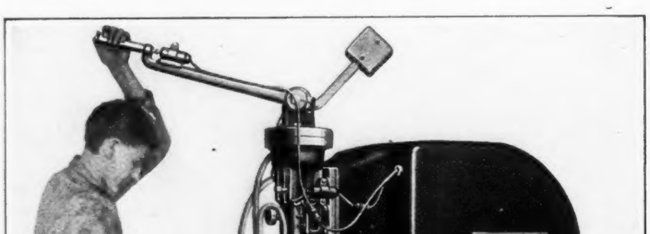


Fig. 10. Toledo Spot-welding Machine welding High-speed Steel Insert to a Lathe Tool. At a Current Cost of Three Cents per Kilowatt-hour, the Cost should not exceed $3 for welding 800 Pieces of ½ by ½ by 2 Inch High-speed Steel—a Day's Work

In all cases it is necessary to have the surfaces of the parts, Fig. 9, absolutely clean and free from oil, dirt, rust or scale. The surfaces where the copper dies make contact should also be clean and parallel. It is necessary to shape the pieces and have their meeting faces perfectly smooth and level in order to get the best results. The current must be applied long enough to bring the metal at the joint to a welding temperature and sufficient pressure must be applied to secure a perfect union at the joint. Spot-welding machines with the toggle joint in the head are particularly well adapted for this service, as they give an almost unlimited pressure when the toggle is straightened out to give the final squeeze, but the work can be done equally well with a butt-welding machine. Welds made by spot-welding can be ground to any desired shape, but they cannot be forged after the weld is made. They do not require the heat-treatment called for when a butt-weld is made, but they should be dropped in an oil bath or rapidly cooled as soon as the weld is completed.

TABLE II. SPOT-WELDER DATA

A Width, Inches	B Length, Inches	K. W. Required	Time in Seconds to Weld	Cost per 1000 Welds at 1 Cent per K. W. Hour
⅜	1½	5	30	0.416
½	2	10	45	1.250
¾	2½	15	60	2.500
1	2½	20	75	4.160

Machinery

Column A gives the width of the high-speed steel bit and column B the length.

The thickness of the stock makes no difference; the feature to be considered in making a weld of this kind is the meeting faces of the high-speed and carbon steel stock.

Alternating current must be used in all cases, as direct current cannot be employed. Single-phase current is required, but this may be obtained from any two- or three-phase source of supply. Any voltage from 110 to 550 volts can be used, and any frequency from 25 to 60 cycles.

In the foregoing, the welding of lathe and planer tools and drills has been chiefly dealt with, but it will be apparent that these processes may be used for welding many other articles, as, for example, shanks to end-mills, and the cutting edges of chisels and similar tools may be made of good tool steel and welded to a cheaper body with a consequent saving in cost. A great many other tools, such as small punches, taps, reamers, etc., are also suggested.

Tables I and II will serve to give a fairly good idea of the cost of welding, time required to do the work and amount of current necessary.

* * *

Gaskets for water and exhaust steam pipings are usually about ⅛ inch thick. Gaskets for live steam piping should not be more than 1/16 inch.

RECENT LEGAL DECISIONS INVOLVING MACHINERY

Machinery Company Allowed Change of Venue

(New York) In the recent case of Climax Road Machine Co. v. Central Bank of Medina, New York Supreme Court, the court allowed a change of venue on application of the machine company on the theory that to refuse the same would work a hardship upon such company.

The Climax Road Machine Co., plaintiff, sold one of its steam rollers to a road contractor, and the Central Bank of Medina took a chattel mortgage on the machine. The contractor became insolvent and made a consignment of his property to the bank for the benefit of creditors. The Climax Road Machine Co. then brought this suit to recover the steam roller, and asked the court for a change of venue to an adjoining county where twenty-five of its witnesses resided, and where the books and papers of the firm were located. The trial court refused to allow the change and an appeal was taken. The Supreme Court of New York held the Climax Road Machine Co. entitled to the change of venue on the theory that to deny the change would place an undue hardship upon the company. *(Climax Road Machine Co. v. Central Bank, 156 N. Y. S. 857.)*

Concealment of Insolvency

(Alabama) Where a buyer of machinery on credit was in failing circumstances and had no reasonable expectation of being able to pay therefor, but failed to disclose his financial condition to the seller, and the seller was ignorant of such condition, and thereby induced to make the sale, it could, upon ascertaining the facts, rescind the sale. Where a sale of machinery was induced by the buyer's concealment of his failing financial condition, the seller's right to rescind existed from the time the sale was made and antedated the lien of the buyer's landlord, and the landlord's lien was subject to the seller's prior right of rescission in the absence of any facts giving rise to an estoppel. *(Parker-Blake Co. v. Ladd, 70 S. 189.)*

What is a Sale of Machinery

(Iowa) A contract to allow a buyer of machinery to use it from the date of the contract to a certain time for a certain payment for its use, payable in installments at different times, evidenced by the buyer's notes, and whereby the buyer agreed to return it if any of the notes were not paid on maturity, and was to receive a bill of sale if the notes were paid on maturity, was a sale of the machinery with a retention of title, within the Iowa law making such sales or leases void as against subsequent innocent purchasers and creditors without notice unless duly acknowledged and recorded the same as chattel mortgages. Here the purchaser of the machinery before full payment of the purchase price made an assignment for the benefit of creditors. The manufacturer of the machinery seized it and claimed title. The court held that the assignment was good, the seller having failed to record the conditional sale contract. *(Haudlon-Buck Co. v. Waterloo Drop Forge Co., 155 N. W. 803.)*

Defective Appliances

(Pennsylvania) The failure of an employer to inspect tools furnished an employe, constitutes actionable negligence, where a reasonable inspection would have disclosed the defects.

Where the operator of a chipping machine in the plant of an engineering company complains to defendant's foreman that the tools with which he is working are dangerous by reason of their frequent breaking, but continues with his work without receiving any assurance that the defects will be remedied, he assumes the risk of injury from such defects. *(Wochner v. Penn. Engineering Works, 96 A. 470.)*

Operator of Defective Machine Allowed to Recover

(Pennsylvania) Where, in a mine employe's action for injuries from defects in a coal-cutting machine which he was operating, it appeared that plaintiff, a foreigner of limited education and unfamiliar with the operation of the machine, told the superintendent of the defects, but was told to return to work and an electrician would be sent to repair the machine, that the electrician, after examining the machine, instructed plaintiff that it could be operated safely in a certain way in spite of the defects, and that plaintiff was injured while trying to follow such instructions, the judgment for plaintiff was authorized. *(Protosenia v. Brothers Valley Co., 96 A. 477.)*

Railroad Held Responsible for Machinery

(Massachusetts) Where machinery was consigned to the shipper at the residence of the purchaser by bill of lading with draft attached providing for notice to purchaser, and the purchaser did not accept the machinery, it was the duty of the railroad company to notify the shipper within forty-eight hours of such refusal. Its failure to give such notice was a breach of the carriage contract, although the purchaser had not notified the railroad that he refused to unload the car. *(South Deerfield Co. v. N. Y., N. H. & H. R. Co., 111 N. E. 367.)*

Positive Duty to Furnish Safe Place to Work

(Kansas) The plaintiff sought to recover damages from his employer and another employe for injuries suffered while he was repairing the machinery of his employer, based on the negligence of the employe, who was an engineer, in starting the machinery while plaintiff was engaged in repairing it and also on the negligence of his employer in failing to furnish him a safe place to work or to give him such warning as would enable him to reach a place of safety before the machinery was put in operation. The jury found that the engineer, who started the machinery on signals given by others and did not see or know that plaintiff was at work upon the machinery, was not liable for the injury suffered by the plaintiff, but also found that the employer, whose duty it was to furnish plaintiff a safe place to work and to keep it safe, was culpably negligent and responsible for the damages sustained. Held, that the finding of the jury that the engineer was not negligent does not necessarily exonerate the employer from liability for nonperformance of the positive duties of a master toward the plaintiff, and that the evidence in the case justified the jury in returning a verdict against the employer. *(Orr v. Ellsworth-Klaner Const. Co., 153 Pac. 526.)*

* * *

UTILIZING SPOILED MUNITIONS

At the outbreak of the present war, many manufacturers went into the munitions business without definite ideas as to the requirements of this work. Consequently a large amount of material was spoiled or made in such a way that it would not pass inspection. One concern lost over 5000 18-pound British cartridge cases, but a novel use was made of these cases. They were placed in a punch press and smashed down so as to form a shallow cup. Soldered on the edges of this cup were two small curved holders which converted the cartridge case into a very satisfactory and attractive cigar and ash holder. The result was that the spoiled cartridge cases sold for a higher price in this form than they would have if sold for munition purposes.

Another large manufacturer, not to be outdone by this experiment, when he found that over 5000 cartridge cases had been spoiled, evolved the idea of making an ornamental beverage holder from a shrapnel shell fuse and cartridge case. The cartridge case contains a rack holding four glasses; inside the shell is a container which holds the beverage, and the fuse acts as a cover. The original shrapnel shell, loaded and ready for firing, sold for $15. This beverage holder, not "loaded" nor made to specifications, sells for $10.

* * *

Bolts are generally measured from beneath the head to the first thread at the end. There is usually a point about 1/16 inch beyond the first thread. Cap-screws with square and hexagonal heads are provided with a thread cut three-quarters of the length for screws one inch and less in diameter, when the screw is less than four inches long. For longer screws the thread is usually cut one-half the length. Fillister-head screws are threaded two-thirds of the length. Screws are classified as set-screws only when the head is not more than 1/16 inch larger in diameter than the body of the screw. When the head is larger they are classified as cap-screws.

AXIAL MOVEMENT FOR HOB

The usual method of cutting a spur or spiral gear in a gear-hobbing machine is to feed the hob downward in a direction parallel to the axis of the gear blank, after setting one of the hob teeth central with the gear blank axis, and inclining the hob in order to align the cutting teeth with the tooth spaces milled in the gear blank. With this method of hobbing, only a few of the hob teeth are used for any one position of the hob,

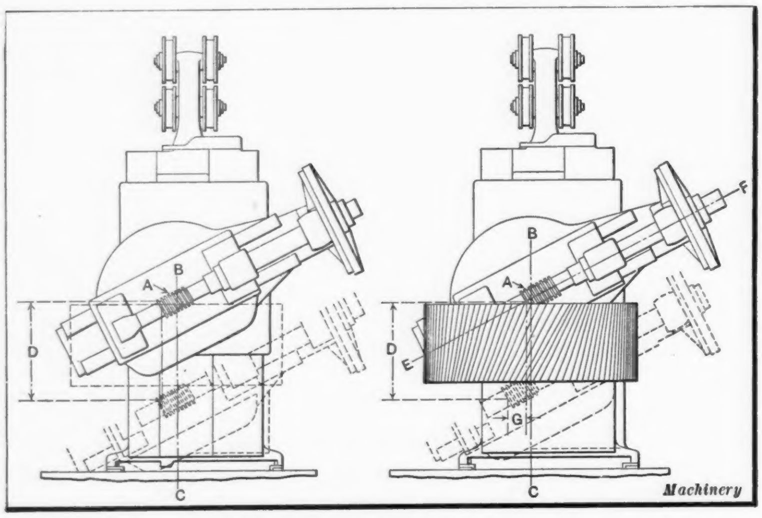


Fig. 1. Diagrams illustrating Ordinary Feeding Movement of Hob, and Method of changing Lateral Position of Hob to distribute Wear

and in order to distribute the wear it is common practice to change the axial position by centering a different hob tooth when setting up the machine for a different lot of gears. In order to insure more uniform distribution of wear, J. E. Reinecker, of Chemnitz-Gablenz, Saxony, has invented a hobbing machine which is so arranged that the hob is moved automatically in the direction of its axis as it feeds downward across the gear blank. The principle of this new process is illustrated by the accompanying diagrams. The view to the left in Fig. 1 represents the milling of a spiral gear in the ordinary way. The hob *A* moves in the direction *B–C*, and traverses a path *D*, the length of which is somewhat greater than the face width of the gear blank. The diagram to the right illustrates how this method is modified in the Reinecker machine. The hob not only travels downward a distance *D*, but it is gradually shifted in the direction of its axis *E–F*, so that it is displaced laterally a total amount *G*, as shown by the position of the dotted lines indicating the lower position of the hob and slide. The diagram Fig. 2 also shows the initial position of the hob as used in a machine of the ordinary type, whereas Figs. 3 and 4 show the initial and final stages of a hob that is automatically shifted in the direction of its axis. The hob moves in a direction *E–F* a distance represented by *J–N*, and while the hob is traversed this distance laterally, the blank is given an additional rotary movement equal to *P–T*, so that the points *JKLMN* of the hob coincide with the points *PQRST* of the blank, respectively. In other words, the machine is so arranged that the speed of the gear blank differs from the normal speed which would be required with an ordinary hobbing machine, just enough to compensate for the lateral change in the position of the hob.

* * *

Someone poring over the old files in the United States Patent Office at Washington the other day, says the *Scientific American*, found a letter written in 1833 that illustrates the limitations of the human imagination. It was from an old employe of the Patent Office, offering his resignation to the head of the department. His reason was that as everything inventable had been invented, the Patent Office would soon be discontinued and there would be no further need of his services or the services of any of his fellow-clerks. He therefore decided to leave before the blow fell.

CIRCULAR SLIDE-RULE FOR SHAFT DESIGNERS*

BY EDWIN S. OBERNDORF†

The illustration presented in this article, when cut out and mounted so that the dial with the inner scales may be revolved on a pivot at the center, provides a slide-rule by means of which problems in shaft design may be rapidly solved with a minimum chance of error. It has, in addition, the usual advantages of a slide-rule over charts with rectangular coordinates, in that a set of corresponding values of results for the given conditions is obtained and this set of results is distinctly shown without being confused with results representing other conditions. The use of the chart may be easily learned, even by those who are not familiar with an ordinary slide-rule. This is especially so in that the scales are arranged so that the placing of the decimal point does not have to be determined, the values being read directly; and the accuracy of the chart is sufficient for all practical work. The circular form was chosen, as it is mounted for use in various ways which will suggest themselves. By means of a pair of dividers, the illustration may even be used without cutting out the scales and mounting them. The formulas involved are:

$$M_t = \frac{63{,}025 \text{ H.P.}}{\text{R.P.M.}} \tag{1}$$

$$D = \sqrt[3]{\frac{5.1\,M_t}{S}} \tag{2}$$

$$M_{et} = M_b + \sqrt{M_b^2 + M_t^2} \tag{3}$$

where M_t = twisting moment in inch-pounds;

M_b = bending moment in inch-pounds;

H. P. = horsepower;

R. P. M. = revolutions per minute;

D = diameter of shaft in inches;

S = stress in pounds per square inch;

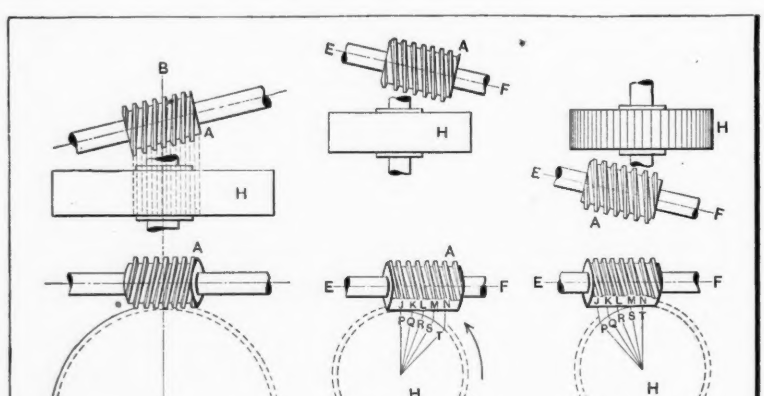
M_{et} = twisting moment equivalent to or producing the same stress as a combined bending moment M_b and twisting moment M_t.

Instructions for the use of the instrument are given briefly under the illustration, so that they may be cut out with it and made a part of the finished rule. A more complete explanation is given in connection with the solution of problems that come under the various cases which may arise.

Case 1. *Shaft Subjected to Torsion Only.*—Given H. P. and R. P. M., find twisting moment and diameter for a

*For other articles on the subject of shaft design published in MACHINERY, see "The Angle of Torsion," November, 1914; "Heavy Duty Shafts with Two and Three Bearings," April, 1914; "On Determining Shaft Diameters," August, 1913; "Intermediate Supports for Long Shafts," January, 1913; "Calculation of Bending and Turning Moments for Round Shafts," July, 1911; "Hollow Shafts," April, 1911; "The Effect of Keyways on the Strength of Shafts," January, 1911; and "Table for Hollow and Solid Shafting," September, 1905.

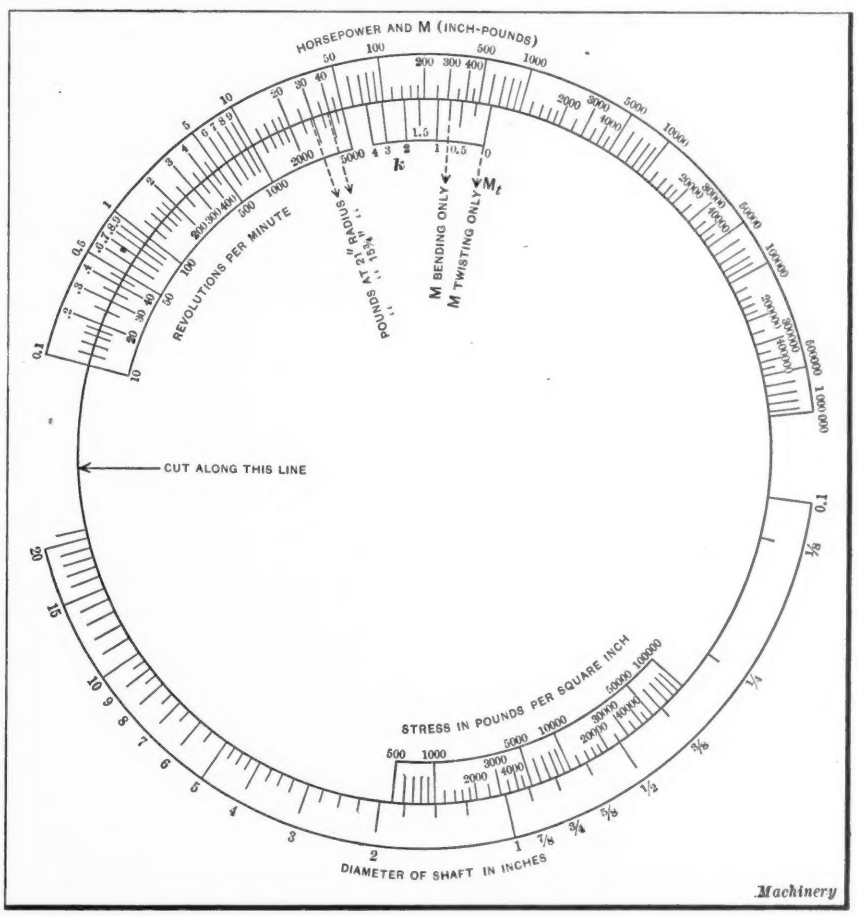
†Address: 234 Fourth St., Jersey City, N. J.



Figs. 2, 3, and 4. Relation between Hob Movements on Ordinary Hobbing Machine and New German Design

given stress, or stress for a given diameter. Set the given H.P. on the outer scale and the given R. P. M. on the revolving scale against each other. On the outer scale read the twisting moment, if required, opposite the mark M_t on the k scale. With the same setting of the dial, read the required diameter under the stress which may be allowed in the material of the shaft. The stress in a shaft of any other diameter may be read at the same time. The values so obtained are those given by Formulas (1) and (2).

Example.—Given a shaft transmitting 35 H.P. at 800 R. P. M. (torsion only, as in a direct-connected motor-generator set). Set 800 on the R. P. M. scale against 35 on the H.P. scale. The twisting moment is read at M_t, and is found to be 2750 inch-pounds. For a shaft stress of 6000 pounds per square inch, the diameter necessary is 1⅜ inch. In a shaft 2¾ inches in diameter, the stress would be 700 pounds per square inch.



For twisting only, scales for H. P., R. P. M., stress and diameter are used. Set given H. P. opposite R. P. M.; then read diameter and corresponding stress opposite each other. Twisting moment may be read if desired, or set when known, on upper scale opposite M_t on dial.

For combined bending and twisting find $k = \frac{\text{Bending Moment}}{\text{Twisting Moment}}$. Set this value of k opposite twisting moment on M scale. Read value of stress opposite shaft diameter.

When k is greater than 4, twisting moment may be neglected. To find shaft diameter required to support a bending moment only, set "M bending only" mark opposite bending moment on M scale. Read value of shaft diameter opposite stress.

Circular Slide-rule for use in solving Problems in Shaft Design, with Condensed Instructions for its Use

Given a twisting moment of 4000 pounds; set the mark M_t ($k = 0$) on the dial against 4000 on the M_t scale. Read diameter and stress as before; at 2500 pounds per square inch stress, the required diameter is 2 inches.

Case 2. Torsion and Bending.—Given H. P. and R. P. M., find shaft diameter, or stress when diameter is given. Find the bending moment in inch-pounds in the usual way. Obtain the twisting moment from the H.P. and R. P. M. scales. Divide the bending moment by the twisting moment, to obtain the ratio k. If this is less than 4, the highest value on the scale, turn the dial clockwise to bring this value of k to the point indicated by $k = 0$ in the first setting, *i. e.*, have the value of k against the given twisting moment. Corresponding stresses and shaft diameters may now be read as before. The constant k is based on Formula (3). If k is greater than 4, *i. e.*, when the bending moment is more than four times the twisting moment, the twisting moment may be neglected. Set the mark "M bending only" against the bending moment read on the outer scale, and read the diameter opposite the stress. With $k = 4$, neglecting the torsional moment gives a stress which is 1.5 per cent low.

Example.—Given a shaft transmitting 35 H.P. at 800 R. P. M. belted motor. The bending moment due to belt pull is calculated as 8000 inch-pounds. The twisting moment found by the instrument is 2750 inch-pounds. This may be used in calculating the bending moment. $k = \frac{8000}{2750} = 2.9$. Hold a pencil point on $M = 2750$, *i. e.*, opposite the zero point of the k scale, and turn the dial clockwise until a point on the k scale estimated at 2.9 is opposite the point located by the pencil. The shaft diameter for a stress of 6000 pounds per square inch is found to be 2 7/16 inches. The stress in a shaft 2¾ inches in diameter would be 5570 pounds per square inch.

Case 3. Bending Only.—To find the required diameter of a shaft or pin for bending only, set the mark "M bending only" against the bending moment read on the outer scale, and read the required diameter opposite the stress.

Example.—Find the diameter of a pin fixed at one end, having a load of 1000 pounds at the free end which is 8 inches from the support. The bending moment is therefore 8000 inch-pounds. Set the "M bending only" mark opposite 8000. With, say, 9000 pounds per square inch stress, the diameter required is about 2⅛ inches.

* * *

ACCURACY REQUIRED IN ROUGHING CUTS

There is a prevailing idea that great accuracy is not essential in roughing cuts, and the expression is frequently heard in the factory, "Oh, that is only a roughing cut; it's plenty good enough," or something of the kind. A great deal of trouble is caused in factory work by neglect of ordinary precautions in keeping up the roughing tools so that they will leave the same amount of stock for the finishing tools to remove. In the manufacture of interchangeable work, variations in the roughing cuts are likely to make an appreciable difference in the sizes obtained after finishing. When boring operations are followed by reaming cuts in cylindrical work it is very important that the roughing tools be kept up so as to leave the same amount of stock for the finishing tools to remove. If this is not done variations will be found in the size of the reamed hole. The same rule applies to other machining operations. For example, large castings which vary in size in their rough state will be found to vary somewhat when finished unless the preliminary operations are so arranged as to leave a uniform amount of stock for the finishing tools to remove. When work is being milled, if one piece has an excessive amount of material on it to remove, more stock will remain for the finishing tool to take off, and therefore the size of the finished piece will vary somewhat.

In boring and reaming cast iron and malleable iron, when the holes are 2½ inches in diameter or larger, it is much better to take medium rough-boring and light finish-boring cuts, leaving from 0.010 to 0.015 inch for the reamer to remove. In this way, there is less likelihood of glazing during the reaming operation, and the results obtained will be much more uniform because the reamer will have sufficient stock to give it a good "bite" in the work. A. A. D.

SHAFTS FOR TORSIONAL STIFFNESS*

BY B. D. PINKNEY†

Shafts for torsional stiffness differ from shafts for transmission purposes in that they are to transmit power through a predetermined angle of twist or torsion, while shafts for transmission purposes are figured according to a safe fiber stress of the material independent of the amount of torsion, the torsion usually being much greater than is permissible for shafts designed for torsional stiffness. The most common instances of shafts to resist torsion are those of double-geared machines, which were treated in my article on the "Angle of Torsion" in the November, 1914, number of MACHINERY.

In the article referred to the formula for the angle of torsion for length of shaft subjected to torsion was given as

$$\Delta = 687.5 \frac{TL}{JG}$$

where Δ = angle of torsion for length of shaft, subjected to torsion;
T = torsional moment in inch-pounds;
L = length of shaft in feet;
J = polar moment of inertia;
G = modulus of torsion.

The angle of torsion per foot of shaft length, then, is:

$$A = 687.5 \frac{T}{JG} \qquad (1)$$

where A = angle of torsion per foot of shaft length.

It was shown that the permissible angle of torsion of shafts varies according to the nature of the service, and is divided into the three following classes:

Class I shafts may have up to 0.05 degree per foot angle of torsion. These shafts are for very heavy service and, as such, are subjected to shocks or fluctuating loads and to reversal under full load.

Class II shafts may have up to 0.075 degree per foot angle of torsion. These shafts are for regular service and, as such, will safely withstand shocks but must not be reversed under full load.

Class III shafts may have up to 0.1 degree per foot angle of torsion. These shafts are for lighter service and not intended for fluctuating loads, unless the fluctuations are gradual; and they should not be reversed.

The value of J for a solid round shaft being

$$J = 0.098\, D^4$$

and, solving for D, Formula (1) becomes:

$$D = 9.15 \sqrt[4]{\frac{T}{AG}} \qquad (2)$$

Inserting the values of the angle of torsion in Formula (2) for the three classifications, and substituting 11,500,000 for G (for cold-rolled or high-carbon steel shafts), we obtain Formulas (3), (4) and (5):

$$\text{For Class I,}\quad D = 0.33 \sqrt[4]{T} \qquad (3)$$

$$\text{For Class II,}\quad D = 0.30 \sqrt[4]{T} \qquad (4)$$

$$\text{For Class III,}\quad D = 0.28 \sqrt[4]{T} \qquad (5)$$

Since, from elementary formulas $T = 63{,}025 \frac{H}{N}$, Formulas (3), (4) and (5), expressed in terms of horsepower, are:

$$\text{For Class I,}\quad D = 5.23 \sqrt[4]{\frac{H}{N}} \qquad (6)$$

$$\text{For Class II,}\quad D = 4.75 \sqrt[3]{\frac{H}{N}} \qquad (7)$$

$$\text{For Class III,}\quad D = 4.41 \sqrt[4]{\frac{H}{N}} \qquad (8)$$

where H = horsepower;
N = revolutions per minute.

SHAFTS FOR TORSIONAL STIFFNESS

(G=11,500,000)

Torsional Moment in Inch-pounds	Diameter of Shaft, Inches			Torsional Moment in Inch-pounds	Diameter of Shaft, Inches		
	Class I	Class II	Class III		Class I	Class II	Class III
100	1.044	0.949	0.885	60,000	5.165	4.695	4.382
200	1.241	1.128	1.053	70,000	5.368	4.880	4.554
300	1.373	1.249	1.165	80,000	5.550	5.045	4.709
400	1.476	1.342	1.252	90,000	5.716	5.196	4.850
500	1.560	1.419	1.324	100,000	5.868	5.335	4.979
600	1.633	1.485	1.386	125,000	6.205	5.641	5.265
700	1.697	1.543	1.440	150,000	6.494	5.904	5.510
800	1.775	1.595	1.489	175,000	6.750	6.136	5.727
1,000	1.856	1.687	1.575	200,000	6.979	6.344	5.921
1,250	1.962	1.784	1.665	300,000	7.723	7.021	6.553
1,500	2.054	1.867	1.743	400,000	8.299	7.545	7.042
2,000	2.201	2.006	1.872	500,000	8.775	7.977	7.446
2,500	2.333	2.121	1.980	600,000	9.184	8.350	7.793
3,000	2.442	2.220	2.072	700,000	9.545	8.678	8.099
4,000	2.624	2.386	2.217	800,000	9.869	8.972	8.374
5,000	2.775	2.523	2.355	900,000	10.164	9.240	8.624
7,500	3.071	2.792	2.606	1,000,000	10.436	9.487	8.854
10,000	3.300	3.000	2.800	1,250,000	11.034	10.031	9.362
15,000	3.652	3.320	3.099	1,500,000	11.548	10.498	9.798
20,000	3.924	3.568	3.330	1,750,000	12.003	10.912	10.185
30,000	4.343	3.948	3.685	2,000,000	12.410	11.282	10.530
40,000	4.667	4.243	3.960	2,500,000	13.122	11.929	11.134
50,000	4.935	4.486	4.187	......	......	......	......

Machinery

Engineers and machine designers invariably use the torsional moment in inch-pounds in preference to terms in horsepower in shafts for torsional stiffness.

The accompanying table is figured according to Formulas (3), (4) and (5). For shafts of medium carbon or machine steel, multiply the figures by 0.98; for bronze, multiply by 0.81; for phosphor-bronze, multiply by 0.83; for maple, multiply by 0.526; for hickory, multiply by 0.513.

Shafts other than of steel frequently are used in special machinery where the action of chemicals and the effects of corrosion are to be considered.

* * *

The appropriation for salaries for assistant examiners in the patent office averages about $10 for each application filed, which means roughly that the examiner may devote to each application about ten hours' time. In an address before the Patent Bar Association at Chicago, the commissioner of patents, Thomas Ewing, intimated that this was not enough time to do the work the patent office ought to do thoroughly. In his opinion, it would pay the public in the greater certainty respecting patents, reduced trouble in the courts, and in the avoidance of complications in business matters, if the government would appropriate at least twice as much as is now appropriated for the work of the examiners.

* For previous articles on the subject of shafting and angle of torsion, see "Distance Between Shaft Bearings" in the May, 1915, number, and other articles there referred to.

† Address: 524 E. 3rd St., Newport, Ky.

LETTERS ON PRACTICAL SUBJECTS

We pay only for articles published exclusively in MACHINERY

THE CONSULAR SERVICE

In the March number of your journal there is an editorial on the consular service in which injustice has been done not only to that service but also to the Bureau of Foreign and Domestic Commerce, which publishes the daily *Commerce Reports*. Criticism is justifiable only when founded on fact, and the facts in this case do not justify this attack upon agencies that are working effectively and efficiently for the promotion of our foreign trade.

The net expense of the consular service for the fiscal year ending June 30, 1914, was $43,674. The expenditures for the service were $2,083,908.42, and the fees collected and deposited in the treasury amounted to $2,040,234.42.

Criticism of the American consular service is largely confined to Americans. Foreign business men, who are on the ground and who know what our consular service can and does accomplish, are as warm in its praise as some Americans are in their criticism. Just one illustration from many that can be cited will suffice to show the high regard in which the service is held abroad. During a discussion at a recent meeting of the British chambers of commerce, President Sterling of the Belfast delegation, and one of the largest linen producers in Great Britain, said that whenever he required exact technical details concerning linen, Belfast's chief industry, he was obliged to seek it in American consular reports, which contained better information concerning linen than the British government or the Belfast trade possessed. A Sheffield delegate, representing one of the great steel industries, said his factory was recently compelled to use a rare mineral alloy, and it was unable to learn about the alloy until it obtained complete details from American consular reports. In fact, the American consular service is considered abroad a service that should serve as a model for other countries.

The Department of Commerce is the sole agency for the dissemination of commercial information collected by the consular service, and the characterization of the items published in *Commerce Reports* as puerile, inaccurate and misleading is as much a criticism of the Bureau of Foreign and Domestic Commerce as of the consular service. In all events, it is extraordinary that MACHINERY should thus characterize reports to which British industrial leaders pay such high tribute.

There was a time when the consular service was used for political patronage, but that time is past. Appointments are now made only after examination, and the examinations are severe tests. Promotions, moreover, are based on efficiency ratings, in the preparation of which the department assists. The present administration, far from deviating from this policy, has strengthened the system of appointment and promotion on merit.

You cite one example of the "inaccurate reports" appearing in *Commerce Reports*—an item relative to restrictions on the importation of machine tools into England. This item, a telegram from the embassy at London, was as follows:

> A royal proclamation, published November 30, 1915, prohibits, after December 21, the importation into the United Kingdom of all machine tools and parts thereof, except small tools. A further exception is made in favor of machine tools and parts thereof imported under the license of the board of trade and subject to the provisions and conditions of such license.

It was stated specifically that machine tools and parts thereof imported under the license of the board of trade were exempted from the general embargo on machine tools, and it is not quite clear why MACHINERY was justified in drawing the "natural inference" that machine tools would be practically barred from Great Britain after December 21.

Upon receipt of a telegram addressed to Richard D. Micou, Mills Bldg., Washington, requesting further particulars in regard to the embargo, a cablegram was sent to Commercial Attaché Baldwin and Mr. Baldwin's reply was published in *Commerce Reports* for December 13, as follows:

> The British importer of machine tools must obtain a license from the board of trade, which, in cooperation with the war munitions board, restricts the disposition and exportation of such articles and regulates profits.

On January 3 Mr. Baldwin's complete report by mail was published in *Commerce Reports* as follows:

> The restriction on the importation of machine tools into Great Britain is a part of the general war control of manufactures, imports, and exports by the government, and the primary impulse in the matter comes from the war munitions board, which controls many factories and, in general, has the power to make such restrictions as may seem necessary for the proper conduct of the war. Machine tools are so important that the board of trade has been requested to take charge of the issuance of licenses for the importation of these products (instead of the war trade department, which furnishes the licenses for export). In order to secure the importation of these machine tools, British importing houses, or manufacturers (as purchasers), must first obtain permission from the board of trade and must make certain agreements with respect to their disposal. Importers who desire to resell machine tools are restricted as to profits in such tools, and definite permission must also be obtained before any such machine tools can be exported. It is apparently not the intention to prevent such importations, but merely to control them in such a fashion that the interests of the government may be served.
>
> I endeavored to secure any papers which might add further details with respect to this matter, but was advised that none was available. It is evident that each specific request for permission to import must be handled at the discretion of the board of trade and the war munitions board. It is probable, also, that the war munitions board will give first call to controlled factories for any incoming machine tools that they may desire to take. With the war munitions board also lies the authority to designate the classes of machine tools which shall be subject to restrictions; and, while I was unable to obtain a statement in regard to this detail, it is apparent that the disposal of those tools which can be used in the manufacture of war material of any kind will be subject to such restriction by the authorities as may be deemed necessary.

In justice to the members of the Consular Service and to the Bureau of Foreign and Domestic Commerce, I know you will be glad to present these facts to the readers of MACHINERY.

Washington, D. C. E. E. PRATT,
Chief of Bureau, Foreign and Domestic Commerce

[The fact is that the item published in *Commerce Reports*, December 6, 1915, quoted in the foregoing, created consternation in the machine tool trade. It is contradictory and absurd as first printed, stating that the importation in the United Kingdom of all machine tools and parts thereof, except small tools, would be prohibited after December 21, and in the next breath that "a further exception is made in favor of machine tools and parts thereof imported under the license of the board of trade and subject to supervision contained in such license." It is true that the department officials very quickly cleared up the matter for those who took the trouble to telegraph to Washington, and credit is due them for the full explanations subsequently published.—EDITOR.]

SHELL TURNING ATTACHMENT

The following describes a shell turning attachment for an engine lathe, which provides for turning the wall of the shell and forming the nose to exactly the required shape, the entire operation being completed at one traverse of the carriage. Referring to the accompanying illustrations, it will be seen that the frame *A* is attached to the saddle by removing the cross-slide and making use of the standard screw and nut. Radius arm *B* is pivoted to cross-slide *C* of the attachment, the pivot

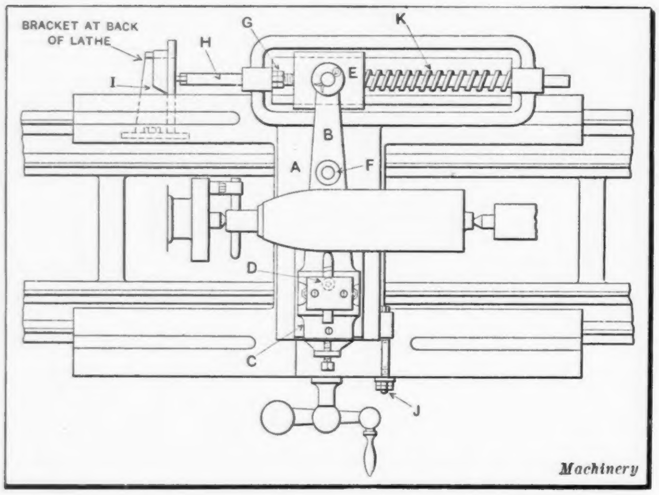


Fig. 1. Shell Turning Attachment with Tool working on Wall of Shell

being located at D; arm B is also pivoted to crosshead E. Carried on arm B there is an adjustable tool-block provided with a tool-setting gage which is pivoted at F to provide for setting the attachment to turn the nose of the shell to the required radius of curvature.

The cut is started at the base of the shell, and while turning the wall, lock-nuts G, carried on rod H which is secured to the crosshead, will rest against the end of the yoke, as shown in Fig. 1. With the crosshead in this position, pivot D is located on the center line of the cross-slide, and the entire attachment travels as a simple unit until the tool reaches the

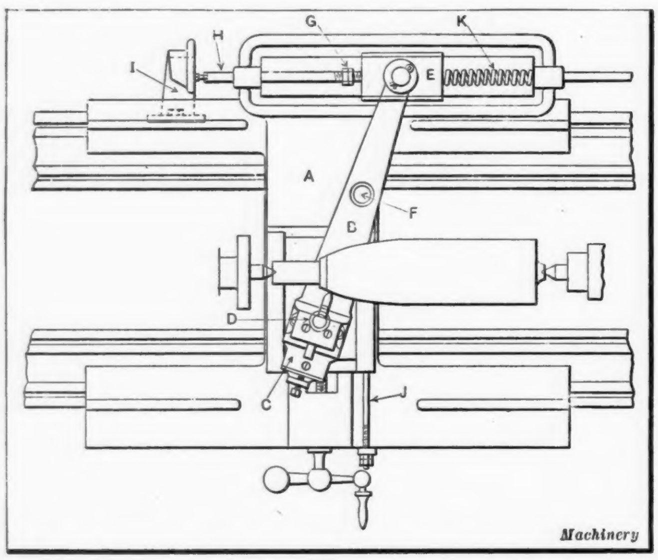


Fig. 2. Shell Turning Attachment with Tool turning Nose of Shell

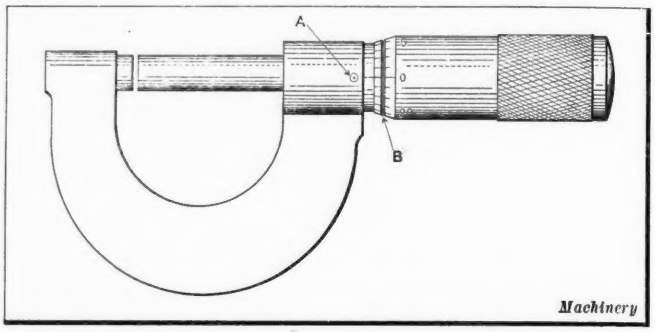
nose of the shell, at which position it is shown in Fig. 1. Rod H now comes into contact with stop I, which is mounted at the back of the lathe, and stops the movement of the crosshead. The lathe carriage continues to travel along the bed and carries the remainder of the attachment with it; this results in arm B swinging on its pivot F, as shown in Fig. 2, thus providing for turning the nose of the shell to the required form. In swinging the arm in this way, the required transverse movement is provided by cross-slide C.

The tool may be moved back from the work without changing the setting of the attachment, and attention is called to stop J, which is provided for the purpose of returning the tool to the working position ready to start a fresh cut. Spring K normally holds crosshead E so that lock-nuts G are held against the yoke; but when rod H engages stop I, continued movement of the lathe carriage results in the compression of this spring. When the carriage is returned to the starting position, it will be evident that spring K automatically returns crosshead E to the extreme left of its travel so that the tool is ready to start turning a new shell.

Hamilton, Ontario, Canada. GEORGE ARMSTRONG

USE OF MICROMETERS TO SET DIVIDERS

The following describes an improvement which I have made on my Brown & Sharpe micrometer—although the same idea can be applied in the case of a micrometer of any other make—in order to adapt the instrument for setting a pair of dividers. Referring to the illustration, it will be seen that a small pin is mounted in the bearing at A; this pin is high enough so that it comes level with the sleeve, and there is a prick-punch mark at the center of the pin. On the cone of the revolving sleeve, a fine circle B is cut across the graduations, the location of this circle being such that it is level with the top of pin A and at a distance of 0.100 inch from the prick-punch mark on



Micrometer adapted for Use in setting Dividers

pin A when the micrometer is set at zero. Then if it is desired to set the dividers to, say, 0.756 inch, adjust the micrometer until the reading is 0.656 inch and then adjust the dividers to bring one point into the prick-punch mark on pin A and the other point into groove B. The dividers will then be accurately set to lay off the distance of 0.756 inch. I think this little kink will be found useful by draftsmen and mechanics who are called upon to do extremely accurate work.

Tottenville, Staten Island, N. Y. JOHN H. NEWSTEAD

NECKING PARTS TO BE HARDENED

Sharp corners and the hardening processes are arch enemies, with the odds favoring hardening, it being universally realized that the way to avoid cracking is to avoid sharp corners and thin sections. A toolmaker will claim that he is taking advantage of these facts to the utmost; but is he? Fig. 1 is an example of the way this point in design is often neglected. The small drill spindles were hardened and ground for bearings at A and B and a gear at C. Quite a few of these parts were lost when hardening due to cracking at D. When precedent was discarded and the spindle turned as shown in the lower view, the work was seldom lost. The edges of the bores

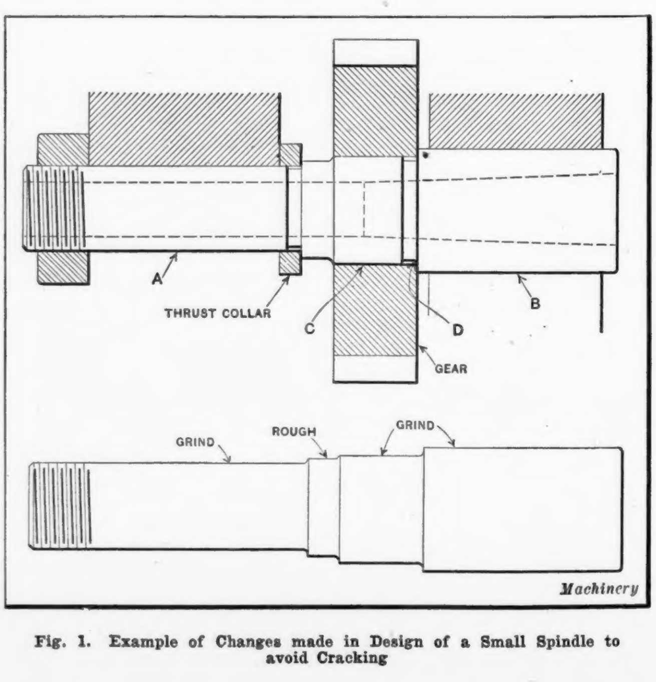


Fig. 1. Example of Changes made in Design of a Small Spindle to avoid Cracking

in the gear and thrust collar had to be rounded, but that costs nothing on a chucking job. Wouldn't it be worth trying to provide all necks on hardened and ground parts with a liberal radius?

When hardened rest-pins or jig feet are to be ground, the toolmaker is usually careful to neck them down, as shown at *A* in Fig. 2, and the sharp corners on this piece allow the development of water cracks. If cracks are detected before assembling, all it means is to try your luck on another piece, and charge up more time to the making of the jig. Why not omit the neck and turn a reasonably large radius under the head, as shown at *B*? This stud still can be ground and the chances of developing a crack are materially reduced. The hole that receives the rest-pin can easily be rounded, as shown

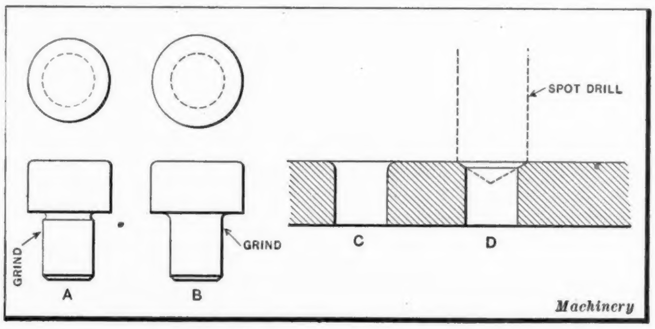


Fig. 2. Method of finishing Jig Feet and Holes to avoid Development of Crack while hardening

at *C*, or as the holes are usually produced by spotting, drilling and reaming, the spot-drill could be used to advantage, as shown at *D*. It is just a little point, but it will help prevent broken jig feet and rest-pins. LAWRENCE FAY

FLUSHING BEARINGS WITH KEROSENE

In the March number of MACHINERY "W. E. R." makes inquiry concerning the possibility of injuring bearings through the use of kerosene for flushing out residue left after the old lubricating oil has been drawn off. In reply, I wish to say that kerosene is undoubtedly a splendid medium for flushing out the bearings, but it is well to remove the kerosene entirely before adding a fresh supply of lubricating oil. This may be done by washing out the bearing with wood alcohol and allowing it to dry before the fresh lubricating oil is added. Alcohol will clean the metal better and more quickly than kerosene or benzine, and there is no possibility of a bad after effect.

New Britain, Conn. WILLIAM C. BETZ

TABLE FOR COUNTING SHELLS

The table presented herewith was developed for the purpose of rapidly determining the number of shells or billets in a pile without actually counting them. Where the billets from

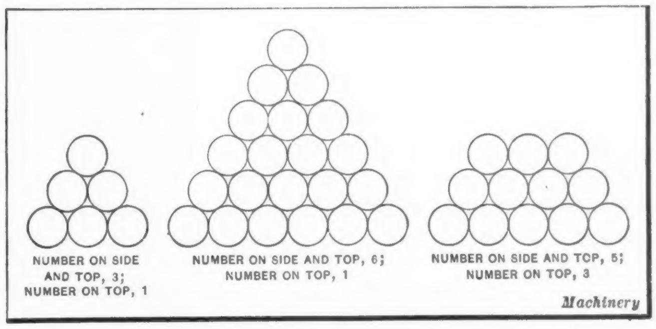


Diagram showing Method of Procedure in using Table

several heats have been placed side by side, so that it is only possible to count the number in the top row and the number in the side row, this table will enable the total number to be determined immediately.

To use the table, count the number of shells on the top row and the number on the side row, the corner shell being counted only once. Now add the number of shells on the top row and on the side row, and referring to the table locate this sum in the left-hand column; then locate the number of shells in the top row of the pile in the top column of the table. Following horizontal and vertical lines from the numbers determined in this way, the point of intersection will give the total number of shells or billets in the pile. The idea will be readily understood by following through one or two problems, making use of the diagram shown in the illustration for that purpose.

Brooklyn, N. Y. JAMES H. CRARY

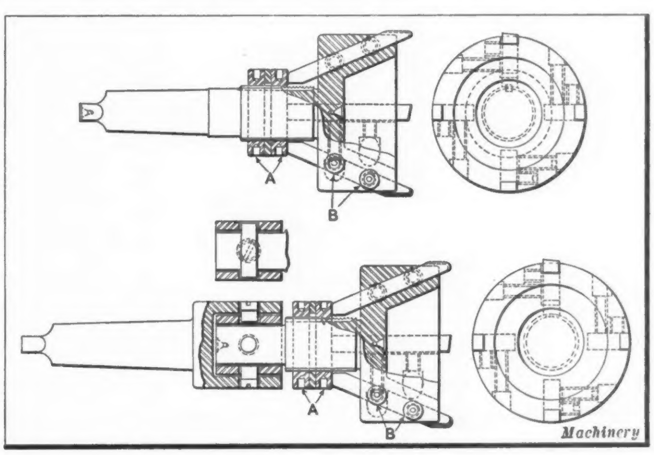
TABLE FOR FINDING TOTAL NUMBER OF SHELLS OR BILLETS IN A PILE

	Number on Top	1	2	3	4	5	6	7	8	9
Number on Top and Side	1	1	...	...	...	...	...	...	...	...
	2	3	2	...	...	...	...	...	...	...
	3	6	5	3	...	...	...	...	...	...
	4	10	9	7	4	...	...	...	...	...
	5	15	14	12	9	5	...	...	...	...
	6	21	20	18	15	11	6	...	...	...
	7	28	27	25	22	18	13	7	...	...
	8	36	35	33	30	26	21	16	8	...
	9	45	44	42	39	35	30	25	17	9
	10	55	54	52	49	45	40	35	27	19
	11	66	65	63	60	56	51	45	38	30
	12	78	77	75	72	68	63	58	51	43
	13	91	90	88	85	81	76	70	63	55
	14	105	104	102	99	95	90	84	77	69
	15	120	119	117	114	110	105	99	92	84
	16	136	135	133	130	126	121	115	108	100
	17	153	152	150	147	143	138	132	125	117
	18	171	170	168	165	161	156	150	143	135
	19	190	189	187	184	180	175	169	162	154
	20	210	209	207	204	200	195	189	182	174

Machinery

ADJUSTABLE CYLINDER BORING-BAR

We had a number of cylinders to bore, the diameters of which varied between 6 and 7 inches. To avoid the expense of making a separate boring-bar for each cylinder, we designed



Adjustable Boring-bars for performing Rough- and Finish-boring Operations in Engine Cylinders

the adjustable tool shown in the accompanying illustration, which met all requirements. It will be evident that the cutters may be adjusted by regulating the position of collars *A* to adapt the bar for boring the various sizes of cylinders which come within its range. After the adjustment has been made by collars *A*, the cutters are rigidly held by tightening setscrews *B*, two of which are provided for securing each cutter. The cutters are made of 5/8-inch square stock and the boring-bar is used on a turret lathe. As extreme accuracy was required, two bars were made, one of which is a solid tool used for performing the roughing operation, while the other is a tool of the floating type used for finish-boring the cylinders.

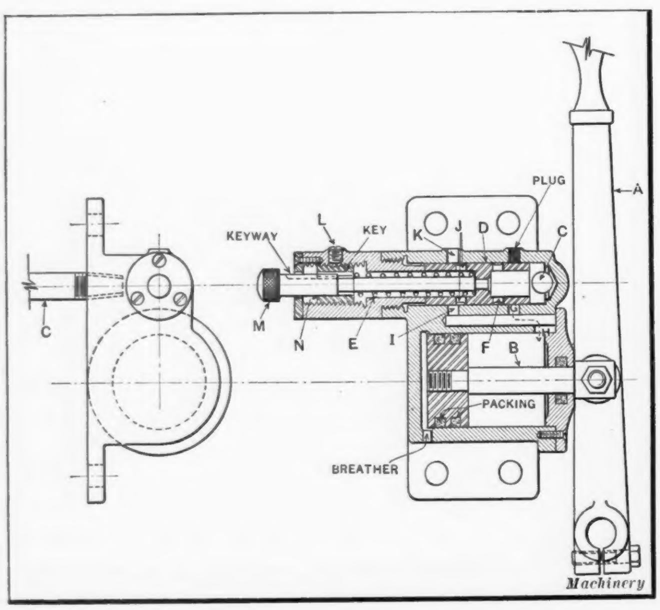
Milwaukee, Wis. MENDEL GLICKMAN

SAFETY VALVE FOR AIR CHUCKS

The automatic air valve here described was designed to prevent accidents on machines equipped with compressed air chucks. Simultaneous demand from a number of air tools or the breaking of an air line is likely to result in a sudden decrease of pressure, and this may cause the work to be

released from the chuck. It is to overcome trouble of this kind that the safety valve was designed.

Referring to the illustration, it will be seen that the lever *A* which is used to start or stop the machine is connected to piston rod *B*, but this does not interfere with the normal operation of the lever. Air pipe *C* is a branch from the main supply pipe of the air chuck, and furnishes pressure to operate hardened steel valve *D* which is held back by spring *E* as long as the air pressure in the line remains normal. If the pressure decreases to a point below the minimum required to operate the chuck, spring *E* throws valve *D* back and admits air to the cylinder through openings *F*, *G* and *H*. Any leakage of air past the valve will not accumulate in the cylinder and cause a shut-down of the machine because it escapes through the by-pass and openings *I*, *J* and *K*.

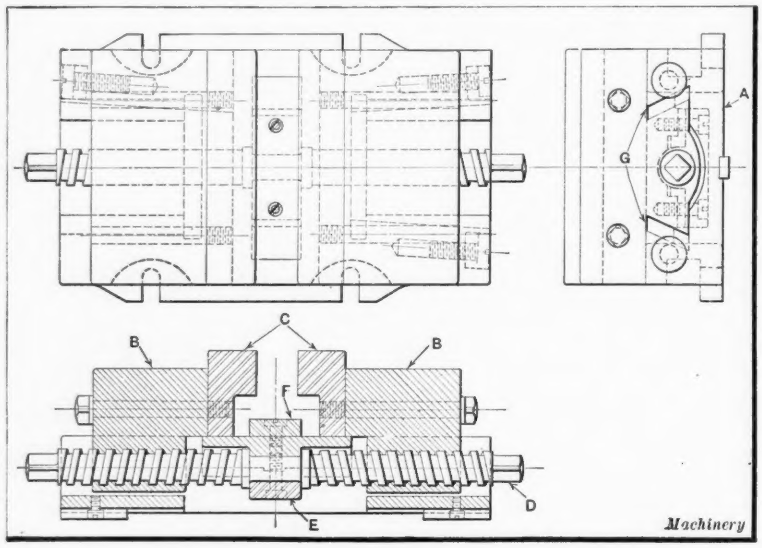


Safety Valve for Air Chuck which shuts down Machine if Air Pressure fails. The Illustration shows Machine shut down by Hand

The tension of spring *E* may be adjusted by loosening a set-screw *L* and revolving knurled rod *M* that is riveted to valve *D*, thus operating screw bushing *N*. As rod *M* moves with valve *D* the position of the valve can be easily estimated; and this is important because if the air pressure is low, it is impossible to start the machine without exerting sufficient force to overcome the total pressure against the piston. This device shuts down the machine if the air pressure falls below the minimum required to hold the work in the chuck; it is sensitive to a variation in pressure of five pounds per square inch and adjustable for any reasonable range. LAWRENCE FAY

SELF-CENTERING MILLING MACHINE VISE

The milling vise described in the following was designed to handle castings, drop-forgings and other parts likely to vary slightly in shape and size. With an ordinary vise any eccentricity of the work results in throwing all the error to one side, and in order to overcome this difficulty I designed the self-centering vise shown in the illustration. It will be seen that the main body *A* holds two sliding jaws *B* to which are secured interchangeable jaws *C* that may be formed to hold work of any desired shape. The movement of jaws *B* is controlled by a right- and left-hand screw *D* which can be operated from either end; this screw moves both jaws an equal distance toward or away from the center of the vise. Screw *D* is secured against end play by a steel bearing *E* which is tongued into the vise body and held by two screws. Cover *F* prevents chips from finding tneir way into the bearing.

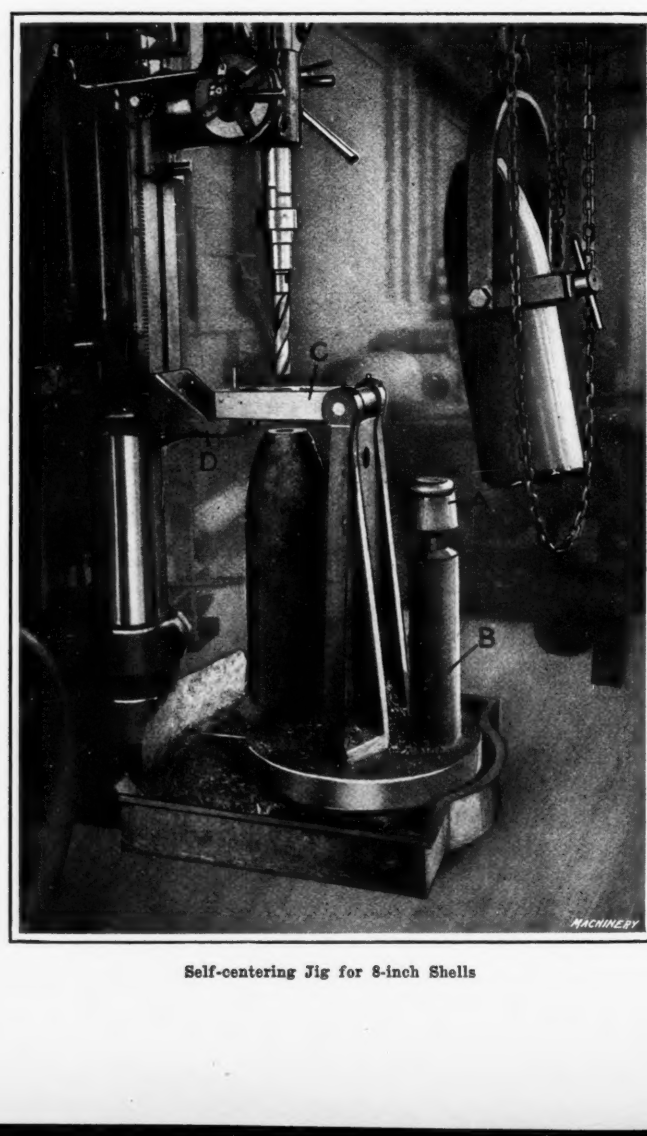


Design of Self-centering Milling Machine Vise

Three taper gibs *G* are employed to keep the sliding jaws *B* in accurate alignment and also to make it easier to fit the parts together. The side having one taper gib is easily scraped in, and as soon as any wear becomes apparent this gib is adjusted. On many small parts which call for a second machining operation—and particularly in cases where a form cutter is employed—it is important for the vise jaws to be held in absolute alignment. By adjusting the two taper gibs at the right-hand side of the vise, the alignment of the jaws can be maintained; and by easing up one gib and forcing in the other, the right-hand slide can be adjusted in either direction. Jaws *C* do not come into contact, and in this way the capacity of the vise is materially increased. AUTOMATIC

SELF-CENTERING JIG

A simple indexing jig for holding 8-inch high-explosive shells has been devised by one manufacturer who handles the various machining operations from a hole drilled through the nose



Self-centering Jig for 8-inch Shells

end of the shell in the first operation. A rotating fixture carries three vertical posts, two of which are bored for a 2-inch diameter piston; one of these pistons is visible at *A*. A heavy spring floats the pistons when not in use, but when a shell is placed over the end its weight causes this spring to be compressed. This expands three plungers *B* located around the posts so as to grip the forging just inside the lower end of the shell. The outer ends of the plungers are corrugated. The weight of the shell thus automatically centers it with the rough-forged hole, and the friction of the plungers is sufficient to prevent the shell turning while the nose is drilled and faced. The leaf *C* holding the locating bushing is hinged to the middle post and is supported by a bracket *D* on the face of the drilling machine column. While one shell is being drilled and faced, the operator removes a finished shell and chucks another to continue the cycle of operations as before. F. L. H.

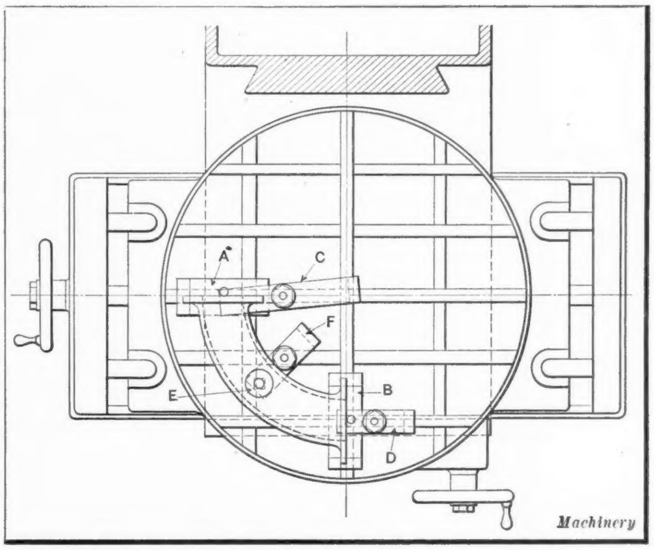


Fig. 2. Method of setting up Work on Circular Attachment of Milling Machine

AN UNUSUAL BORING OPERATION

There are few machining operations which present greater difficulties than boring around a corner, and this is particularly hard when the corner is a long one and extends through an angle of ninety degrees, as in the case of the work shown in Fig. 3. The writer recently saw such a boring operation accomplished in an ingenious manner and felt that, despite a somewhat general belief to the contrary, there really is something "under the sun" worth knowing about. The part to be machined was a right-angle elbow 4 inches in diameter, which was to be used for experimental work, and it was required to bore the holes in twelve pieces.

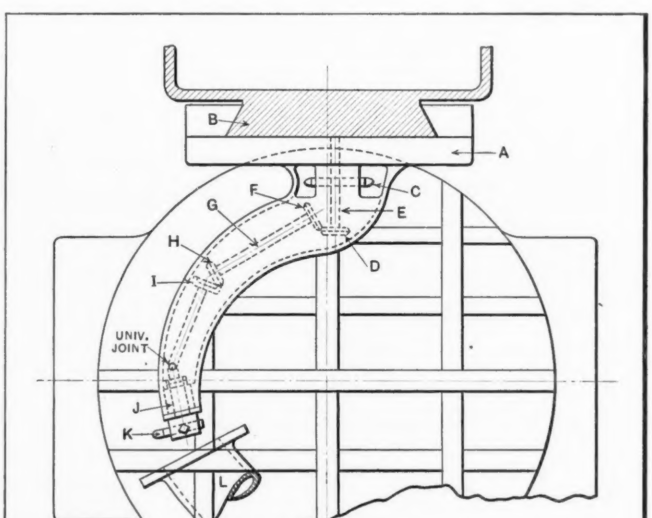


Fig. 1. Design of Special Boring-bar for machining Piece shown in Fig. 3

In preparing for handling this job it was necessary to consider two points: first, the method of holding the work; and, second, the means for getting the tool to follow the hole. Fig. 2 shows the method which was adopted, and the results obtained were highly satisfactory. The work was set up on a horizontal milling machine provided with a circular milling attachment, and supported by two V-blocks *A* and *B*. The work was held down by two clamps *C* and *D* placed over the V-blocks, and an adjustable jack *E* was placed under the center of the elbow, with a third clamp *F* over it. The piece was located at the proper distance from the center of the circular milling attachment to obtain the required radius of curvature.

The boring tool was really a unique part of the equipment, and the best idea of how this outfit operated will be obtained by referring to Fig. 1. It will be seen that bracket *A* is curved so that it will not obstruct the work as it is rotated by the table of the circular milling attachment. This bracket is mounted on the vertical slide *B* which carries the knee of the milling machine. A suitable bearing is provided in bracket *A* to support sprocket *C* and bevel gear *D* on shaft *E*. This drive transmits power to gear *F* on shaft *G*, and thence through gears *H* and *I*, and the universal joint to spindle *J* which carries fly-cutter *K* that bores the hole. In this illustration the work is shown at *L*, and referring to the lower view, it will be seen that power is taken from the milling machine spindle and transmitted through chain *N* and sprocket *M*.

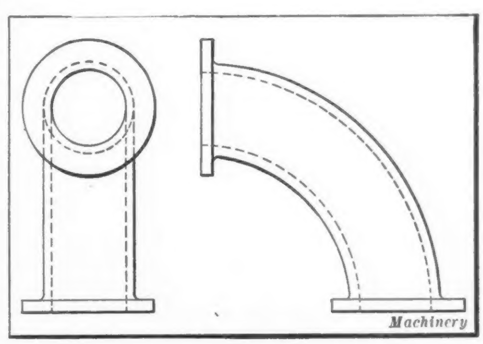


Fig. 3. Piece in which Hole is to be bored

When setting up this outfit, the circular milling attachment is mounted in such a way that the fly-cutter will occupy a radial position. The table of the machine is locked and the knee is also locked after bringing the cutter into a central position in the vertical plane. Then by starting at the position shown in Fig. 1 and rotating the circular milling attachment, the work is fed over the cutter so that the hole will be bored to the required shape. SERVER

TOOLS MOUNTED WITH CUTTING EDGE DOWN

The advantage of a spring tool or so-called "gooseneck" tool is known to most machinists, the smooth cutting action of this tool having been explained by many mechanical writers. But comparatively few machinists use an ordinary tool mounted with the cutting edge down to obtain a similar result, although this practice could often be advantageously employed; and still fewer men would be able to give a reasonable answer if asked to explain the benefit resulting from such a practice.

It is an established fact, however, that chatter and breakage of delicate tools are often materially reduced by mounting the tools with the cutting edge down, the principal reason being that the spring of the tool and support tends to relieve the pressure at the point, making the action similar to that of a gooseneck tool.

For instance, owing to the excessive overhang, boring tools are quite likely to chatter. A boring cut is usually a light facing cut, and the fine finish generally required makes it particularly important to avoid chattering and digging in of the tool. By mounting the tool with the cutting edge down, as shown at *A*, relief will be provided which will insure obtaining satisfactory results. At *B* the tool is shown mounted with the cutting edge up, and it will be evident that here the pressure of the cut will result in springing the tool point down and causing it to dig into the work. The lower the center about which the tool point swings, the greater will be the trouble from this cause, and consequently the more imperative becomes the need of mounting the tool with the cutting

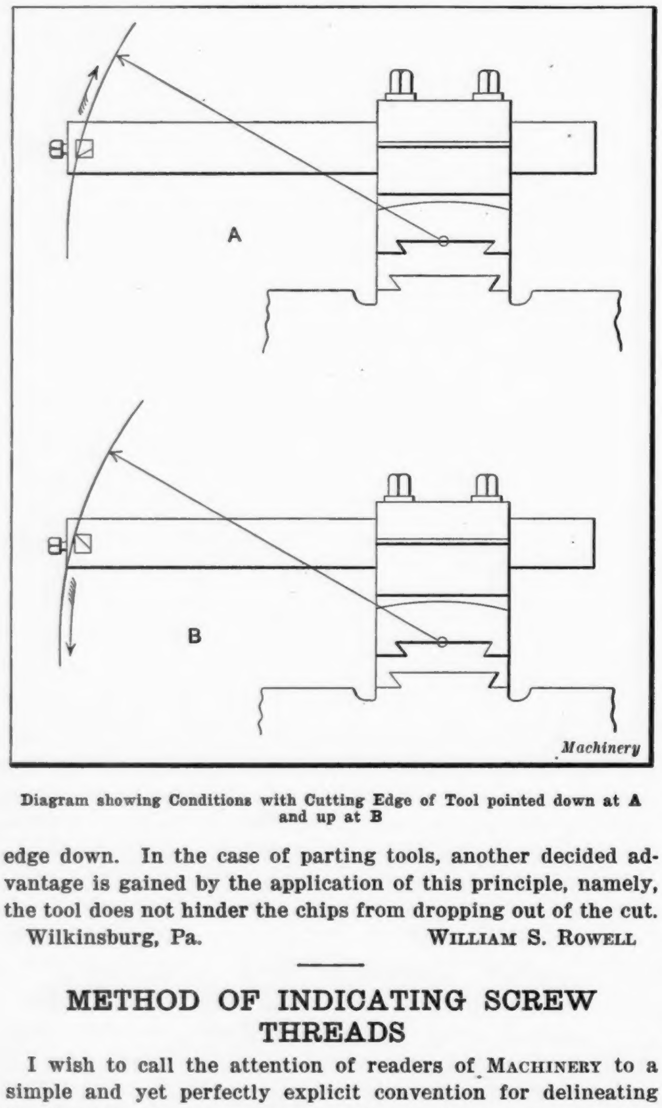


Diagram showing Conditions with Cutting Edge of Tool pointed down at A and up at B

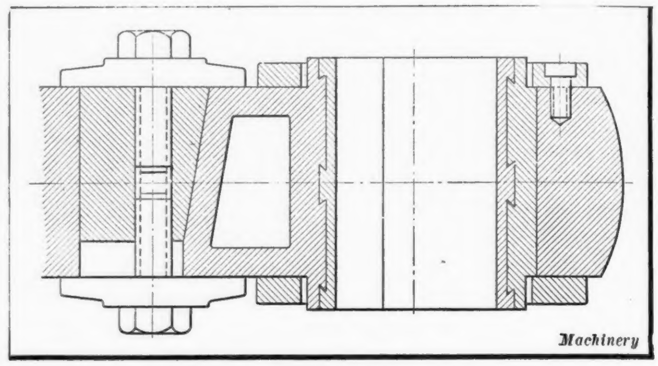
edge down. In the case of parting tools, another decided advantage is gained by the application of this principle, namely, the tool does not hinder the chips from dropping out of the cut.

Wilkinsburg, Pa. WILLIAM S. ROWELL

METHOD OF INDICATING SCREW THREADS

I wish to call the attention of readers of MACHINERY to a simple and yet perfectly explicit convention for delineating the threads of screws. While this may have come to notice before in the foreign prints, it has, so far as I know, never appeared in American drafting practice. Its simplicity and clearness should strongly recommend it to draftsmen generally. The accompanying illustration is reproduced from a portion of two cuts in a German work on connecting-rods and crossheads, which is one book of a number I have found using this convention. The illustration is self-explanatory. The outlines of the bolts are drawn in the usual way; the depth of thread and the upper and lower limits of threading are indicated by dotted lines parallel and perpendicular to the axis of the bolt, respectively.

This convention will save a great deal of time as compared with the usual method of drawing inclined lines to represent the inclination of the threads. Its use will result in greatly



Conventional Method of indicating Screw Threads

clarifying intricate and detailed views, as the distraction of the eye occasioned by the large number of lines required to represent a threaded member in the old way does not occur with the manner of representation proposed. This convention should have a strong appeal to designers and draftsmen; the time saved and clearness gained are of undoubted value, and if there are any serious objections to the practice outlined, they are not apparent to the writer.

Washington, D. C. F. J. SCHLINK

SELECTIVE OR LOCAL HARDENING

On page 512 of the February number of MACHINERY, Paul Cyr tells of his experience in developing a method for hardening a die around a cutting edge and leaving the rest of the steel soft. Mr. Cyr would have obtained better results and done his work more easily by using a compound known as "enamelite" which is made by the Shore Instrument Co. of New York City. This compound is applied to those surfaces of the work which are to be left soft, the degree of softness obtained depending on the thickness of the film of enamelite which is applied to the work. Where it is required to leave the metal very soft, the coat of enamelite should be about 3/16 inch thick.

The ability of this compound to keep the metal soft is due to the fact that when heated it liberates hydrogen gas which is held in a film around the heated steel and keeps the quenching fluid from coming into contact with it. Naturally this prevents the steel from hardening, while those portions of the work which are not coated with enamelite are reached by the quenching fluid and hardened in the usual way. Enamelite can be used in hardening steel by quenching in water or oil, and it can also be used where a lead bath is employed for heating; but it cannot be used in a salt bath, as the salt decomposes the enamelite and renders it useless. The best results are obtained by using enamelite in an open-fire furnace.

New Britain, Conn. W. C. BETZ

TURNING ECCENTRIC BUSHINGS

The writer is frequently called upon to turn eccentric bushings of the form shown in Fig. 1, and in handling work of this kind, he uses the special form of arbor illustrated in Fig. 2. It will be seen that this is made after the pattern of the "Champion" expanding arbor with the addition of adjustable centers to provide for obtaining the required eccentricity. These arbors were designed by a foreman in the machinery division department of the United States Navy at Boston, Mass., and enable extremely accurate work to be turned out in a relatively short time.

The operation of turning an eccentric bushing with this

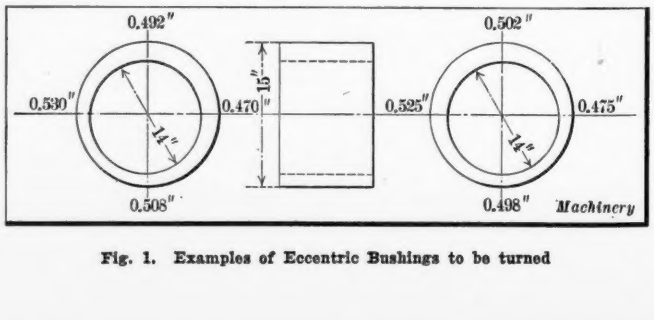


Fig. 1. Examples of Eccentric Bushings to be turned

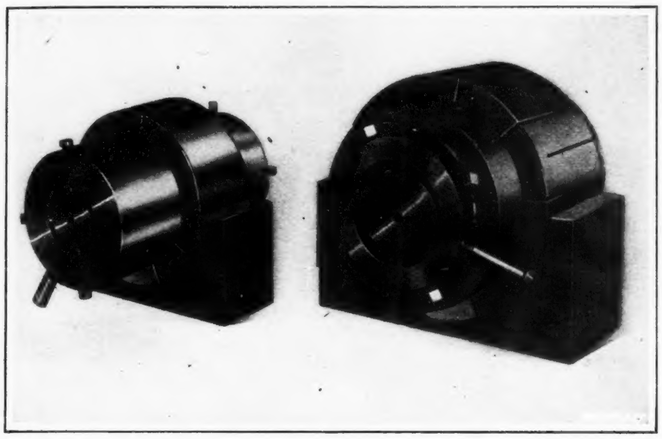


Fig. 2. Expanding Arbor with Adjustable Center for turning Eccentric Bushings

tool is as follows: In the case of one of the bushings shown in Fig. 1, the first step consists of boring the work out to an inside diameter of 14 inches, after which it is placed on the arbor and the centers adjusted to give approximately the desired eccentricity. After this setting has been made a trial cut is taken to see what amount of eccentricity has been obtained, and the centers are adjusted in a direction shown to be necessary. This method of taking a trial cut and resetting the centers is continued until exactly the desired eccentricity is obtained. It should be borne in mind that while these trial cuts are being taken the work is considerably over size, and after the centers have been adjusted to give the required eccentricity, the outside diameter of the bushing is turned down to the required size.

Boston, Mass. N. I. Mosher

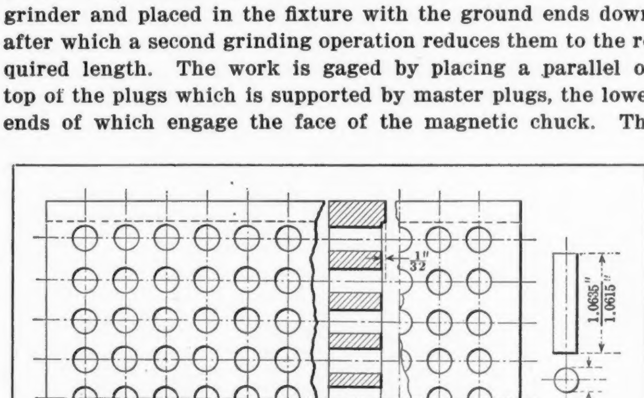
SETTING ONE PAIR OF CALIPERS TO ANOTHER

It is much easier and quicker to set a pair of calipers to the size indicated by a second pair of calipers by holding the tools at right angles to each other than by holding them end to end. The reason for this is that the points of the calipers are round and when the tools are held end to end it is difficult to keep the points from slipping over each other.

Milwaukee, Wis. W. E. Butler

PLUG GRINDING FIXTURE

For use in accurately grinding to length short cylindrical plugs of the size shown, we designed a fixture which has given very satisfactory results. It holds 100 plugs and is used in connection with a magnetic chuck on a No. 2 Brown & Sharpe surface grinder. The plugs are a free sliding fit in the holes in the fixture, and in grinding them a "clean-up" cut is first taken over one end of all of the plugs. The fixture is then removed from the chuck and turned over so that the plugs drop out; and they are then taken to a speed lathe on which the ground ends are burred up. The work is next returned to the grinder and placed in the fixture with the ground ends down, after which a second grinding operation reduces them to the required length. The work is gaged by placing a parallel on top of the plugs which is supported by master plugs, the lower ends of which engage the face of the magnetic chuck. The



Fixture used for grinding Ends of Short Plugs

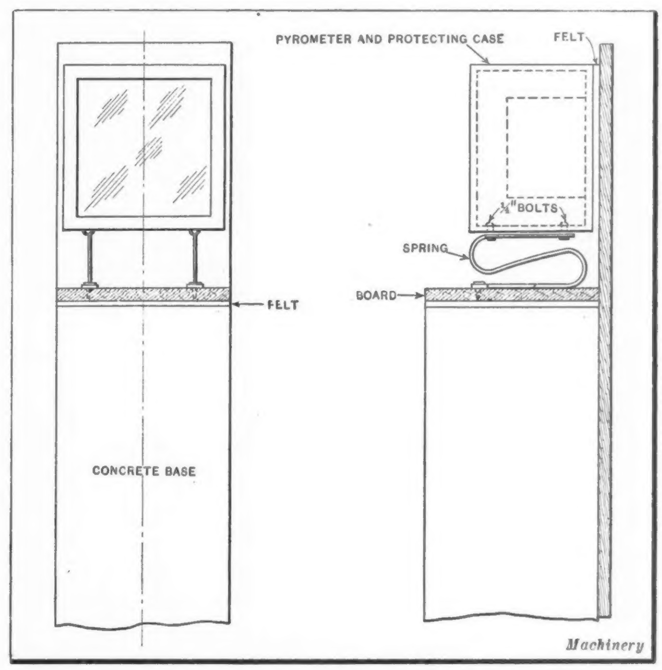
plugs project about 1/8 inch above the surface of the fixture, so that further tests may be performed by removing one or two plugs and measuring them with a micrometer. When the final grinding operation has been performed, the upper ends of the plugs are burred, after which they are ready for use.

Plainfield, N. J. J. B. Murphy

SPRING STAND FOR PYROMETERS

Trouble is often experienced with pyrometers used in forge shops due to the vibration caused by heavy power hammers, and this difficulty may be experienced in cases where a pyrometer is mounted at some distance from the hammer. The impact of the hammer interferes seriously with the reading of the instrument, as the vibration set up causes the indicator to quiver in such a way that it is practically impossible to secure an accurate reading.

We tried two or three methods of overcoming this trouble, but the one here illustrated gave the most satisfactory results. It consists of a concrete base, upon which is placed a layer of felt, a board, and a spring made of 3/16-inch round spring steel which is secured to the case of the instrument. A layer of



Spring Stand for Pyrometer to absorb Vibration from Power Hammers

felt is also put between the case and the board which forms the back of the stand. After the pyrometer was mounted on this stand, no trouble was experienced through quivering of the needle.

L. K.

RING VS. LINE STRAIGHTENING OF RIFLE BARRELS

Referring to the editorial note regarding the concentric method of observation when straightening rifle barrels, which appeared with my article, "Drilling, Reaming and Straightening Rifle Barrels," in the April number, I wish to say that in Avis & Co.'s plant in West Haven, Conn., we have nearly thirty barrel straighteners, including beginners. We would not think for an instant of employing a ring straightener, because we know that method is far from being the best. When a barrel straightener uses the ring method, it is because he cannot use the line method, which is more difficult and gives far better results. The ring method simply means lining up one part of the interior surface of the barrel with another part; in other words, straightening barrels at different points but not from end to end. Line straightening, on the other hand, means straightening every inch of the bore of the barrel from end to end. None of the important sporting gun makers would tolerate the ring method of straightening for an instant.

Whitneyville, Conn. William H. Avis

HOW AND WHY

QUESTIONS ON PRACTICAL SUBJECTS OF GENERAL INTEREST

NUMBER OF B. T. U. IN HORSEPOWER-HOUR

T. T. H.—A horsepower-hour is said to be equal to 2545 B. T. U.; how is this number determined?

A.—If a machine having a capacity of one horsepower were to run for one hour, it would perform 1,980,000 foot-pounds of work. Since one B. T. U. is equal to 778 foot-pounds of work,

$$\text{one horsepower-hour} = \frac{1{,}980{,}000}{778} = 2545 \text{ B. T. U., very nearly.}$$

It should be noted that a horsepower-hour is not a unit of power, but a unit of work, and is equal to 1,980,000 foot-pounds. Similarly, 200 horsepower-hours may mean the work done by a 200-horsepower machine in one hour, or by a 25-horsepower machine in eight hours, etc., but in any case, it would equal $1{,}980{,}000 \times 200 = 396{,}000{,}000$ foot-pounds $= 2545 \times 200 = 509{,}000$ B. T. U. J. J.

DURABILITY OF LIMIT GAGES

F. E. W.—How long will an outside limit gage last when used for gaging three-inch high-explosive shells? How many limit gages should be provided for a plant turning out 1000 shells per day of ten hours?

A.—No reliable data on the durability of limit gages are available. Records of the life of gages are imperfect, and even if perfect records were available they would not serve directly as the basis for estimating what might be required in a plant producing a totally different product under different conditions, except in a very general way. Small limit gages have been used to measure as high as 150,000 pieces, which were required to be kept within limits of $\pm$ 0.00025 inch. A great deal depends upon the condition of the work gaged, the character of the labor using the gages, and the limits imposed. Two sets of gages should be provided in a plant turning out high-explosive shells, one set being used in the shop while the other is being repaired and adjusted in the tool-room.

COLORED DRAFTSMEN

A. T. C.—Why is it we see so few colored men employed in drafting-rooms of manufacturing establishments? It seems to me that drafting offers inducements to colored men having some technical education.

A.—There are two principal reasons why colored men are not more often employed as draftsmen, the first being the race prejudice which bars them from many other occupations, and the second that very few colored men have acquired the knowledge of drawing and machinery required to fit them to be draftsmen. A letter addressed to the Tuskegee Normal and Industrial Institute elicited the information that very few colored men are employed as draftsmen, there being only one or two in Philadelphia and about the same number in Cleveland, Chicago, Boston, Milwaukee and Quincy, Mass. A few colored men have gone to architectural schools and are practicing as architects in the South, but comparatively few have taken up mechanical drawing, as they realize how difficult it would be for them to obtain positions.

LENGTH OF A METER

H. R. L.—In the March number of MACHINERY, page 585, it is stated that Congress legalized the meter and decided that it is equal to 39.37 inches. It is also stated that, according to the *Encyclopaedia Brittanica*, a meter is equal to 39.370113 inches. Does this mean that a meter has two different lengths?

A.—It does not; the lengths of all meters are alike, theoretically. The standard meter is the distance between two marks on a certain metal bar, which is preserved in the International Bureau of Weights and Measures at Paris. Copies of this were constructed and delivered to various governments in the year 1889, and the U. S. government got meters Numbers 21 and 27. These copies are as exact reproductions as it is possible to make. The effect of making a meter contain exactly 39.37 inches was to change the length of the inch, which previous to the Act of Congress referred to was 1/36 of a standard yard. The standard yard is defined in two ways: In Great Britain an Act of Parliament (18 and 19 Vict. cap. 72) defines the yard as the distance at 62 degrees F. between the centers of the transverse lines in two gold plugs in the bronze bar deposited in the office of the Exchequer. By a former Act of Parliament, the foot is $1 \div 3.26159$ of the length of a simple pendulum, beating seconds at the Tower of London, the yard being three such feet. Both of these yards are supposed to be identical, and the U. S. standard yard has the same value. Consequently, what we may call the metric inch is a trifle longer than the yard inch. In England, the value most commonly used for the meter is 39.37079 inches, while in this country, the value is usually stated as 39.370432 inches. The value quoted above is a more recent determination and is more accurate. The different values were arrived at by different persons, and they illustrate strikingly the difficulties of measuring distances correctly to more than five or six significant figures. J. J.

NUMBER OF WATTS IN A HORSEPOWER

O. J. D.—A horsepower is said to be equal to 746 watts; please explain how the number 746 is arrived at.

A.—The fundamental equation of dynamics is $F = ma$, in which F is the force that will produce an acceleration a in a body having a mass m. Since $m = \frac{W}{g}$, $F = \frac{W}{g}a$, in which W is the weight of the body and g is the acceleration due to gravity attained by a freely falling body at the point where the body is weighed. In the English system of measures, F and W are measured in pounds and a and g in feet per second per second, or as some writers put it, in feet per second^2. In the C. G. S. system, the unit of force is the dyne, the unit of mass is the gram (0.00220462 pound), the unit of acceleration is one centimeter ($= 0.0328087$ foot) per second^2, and the acceleration due to gravity is taken as 981 centimeters per second^2. Letting D represent the force in dynes, and substituting in the above equation the English equivalents for the weight and accelerations:

$$1D = \frac{0.00220462 \times 0.0328087}{981 \times 0.0328087} = 0.00000224732 \text{ pound.}$$

The C. G. S. unit of work is the erg, which is one dyne-centimeter ($= 1D \times 1$ centimeter); this unit is too small for most purposes, and, hence, the practical unit is the joule, which is 10,000,000 ($= 10^7$) ergs. Consequently, 1 joule $= 10^7 \times 0.00000224732 \times 0.0328087 = 0.737317$ foot-pound, and

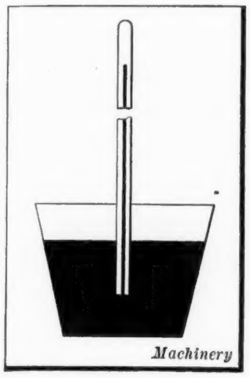
$$1 \text{ foot-pound} = \frac{1}{0.737317} = 1.32346 \text{ joule.}$$

The C. G. S. unit of power is the watt, which is 1 joule per second; hence, 1 horsepower $= 550$ foot-pounds per second $= 550 \times 1.32346 = 745.9485$ joules per second $= 746$ watts, very nearly. According to the U. S. Bureau of Standards, the horsepower is exactly equal to 746 watts when that value of g is used which corresponds to sea level and latitude 50 degrees, which is very nearly the latitude of London. J. J.

ATMOSPHERIC PRESSURE ON MERCURY COLUMN

B. L. R.—Please explain why the pressure of the atmosphere makes the mercury stand in a barometer tube.

A.—In order for any liquid to be at rest, it is necessary that the pressure on any particle of it be the same in all directions—upward, downward, or sideways. Otherwise, if there is less pressure in some particular direction, the liquid will



Atmospheric Pressure on Mercury Column

flow in that direction. Referring to the illustration, take a glass tube about three feet long, fill it with mercury, close one end, and with the finger over the other end, stand the tube in a cup of mercury, as shown. On removing the finger, the column of mercury will be found to be about 30 inches in length between its top and the top of the mercury in the cup. The pressure is exerted all over the top of the mercury in the cup, except on the area occupied by the hole in the tube. This pressure is transmitted in all directions, and presses upward on the bottom of the tube; as the space above the column of mercury is a vacuum, the weight of the mercury in the tube must exert a downward pressure exactly equal to the upward pressure on the mercury column due to the atmosphere. This should answer your question, since the essential features of a mercurial barometer are a cup of mercury and a glass tube having a vacuous space above the mercury column. J. J.

TO DIVIDE A STRAIGHT LINE INTO ANY NUMBER OF EQUAL PARTS

A. C.—How can I divide a straight line (graphically) into any number of equal parts?

A.—Assuming that the line can be placed at will, draw a horizontal line AB, Fig. 1, using a T-square, and make it equal in length to the given line. At one end, say B, erect a perpendicular BC with the T-square and a triangle. Let n represent the number of parts into which the line is to be divided. Take n divisions on the scale, of such length that when the 0 mark of the scale is placed at A, the end of the nth division will fall on the line BC at a point D. Draw AD, and with a sharp pencil prick the division points 1, 2, 3, etc. Through these points, using the T-square and triangle, draw the vertical lines 1-1′, 2-2′, etc. Then $A1' = 1'2' = 2'3'$, etc. $= AB \div n$. This construction is very accurate and rapid. When the line is on a drawing and is not horizontal, use the method shown in Fig. 2.

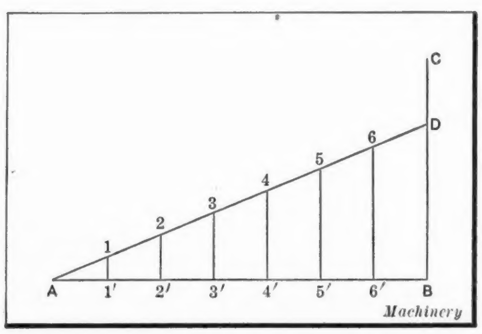


Fig. 1. Graphical Method of dividing a Given Line into any Number of Equal Parts

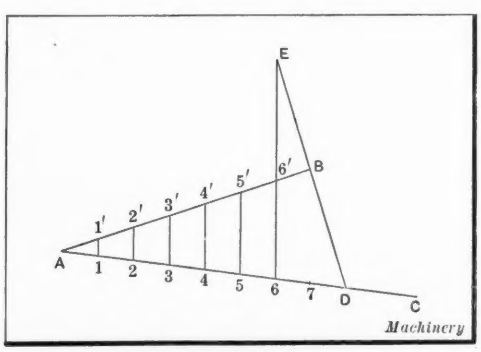


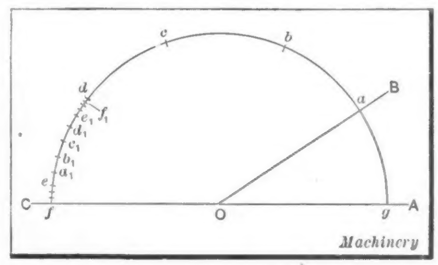
Fig. 2. Another Method of dividing a Line into a Number of Equal Parts

AB is the given line. Draw a line AC of indefinite length, and lay off with a scale or space off with dividers $n + 1$ equal spaces from A, the end of the $n + 1$ division being the point D. Draw DBE, and make $BE = BD$. Through E and the point marking the second division from D, draw $E6$, intersecting AB at 6′. Then $6'B$ is $\frac{1}{n} \times AB$. The other divisions are found by drawing lines through the points 5, 4, etc., parallel to $E6$. In both figures, the line AB has been divided into seven equal parts; *i. e.*, $n = 7$. This construction is also rapid and gives very accurate results. It should be understood that a graphical construction, particularly when the result depends upon the location of points of intersection, may be mathematically correct, while the construction itself may not give accurate results in practice. J. J.

GRAPHICAL METHOD OF MEASURING ANGLES

F. A. M.—Is there any reliable method of measuring an angle without using a protractor?

A.—The following method is due to de Lagny, who made it public about 1724; it is very exact and is readily applied. Referring to the illustration, let AOB be the angle to be measured. Produce one side, say, OA to C, and with O as a center and any convenient radius (the larger the better) describe a semicircle whose diameter shall coincide with AC. Now place one leg of the spacing dividers at g and the other at a and space off the arc ag along the semicircle, stopping at e. Then space off the arc ef from e toward d, stopping at the point f_1, f_1d being less than ef. Then space off f_1d from f_1 to e_1, and note that the stopping point practically coincides with the point e_1. The semicircle is equal to $5 \times$ arc ag + arc ef. Arc $ed = 6 \times$ arc $ef + f_1d$. Arc $e_1f_1 = 3 \times$ arc f_1d, very nearly. These numbers 5, 6, and 3 are the denominators of the continued fraction $\cfrac{1}{5 + \cfrac{1}{6 + \cfrac{1}{3}}}$ which, as is readily seen, is equal to $\frac{19}{98}$. In other words, the angle AOB is very nearly $\frac{19}{98}$ of a semicircle, and $AOB = 180 \text{ deg.} \times \frac{19}{98} = 34.9$ deg. = 34 deg. 54 min. The accuracy of the result depends on the care exercised in spacing; if great pains are taken, it is claimed the error will not be more than one or two minutes. J. J.



Graphical Method of Measuring Angles

FORMULA FOR FINDING AREA OF SEGMENT OF CIRCLE

L. N. P.—Please give a formula for finding the area of a segment of a circle in terms of the chord and height or radius.

A.—Referring to the illustration, let

$$r = \text{radius} = OA = OC = \frac{c^2 + 4h^2}{8h};$$

c = chord of arc = AC;

h = height of segment = DB;

V = central angle = AOC;

A = area of segment $ABCDA$.

Then

$$A = \frac{r^2}{2}(V - \sin V), \text{ when } V \text{ is in radians}$$

$$A = \frac{r^2}{2}\left(\frac{\pi}{180}V - \sin V\right) = \frac{r^2}{2}(0.0174533\,V - \sin V), \text{ when}$$

V is in degrees.

This formula may be readily solved with the aid of a table of trigonometric functions, provided the central angle is known. In practice, mechanics usually measure the chord and the height, in which case, $\tan BAC = \tan \frac{AOC}{4} = \frac{2h}{c}$, from which angle AOC is easily found. Mathematicians have failed

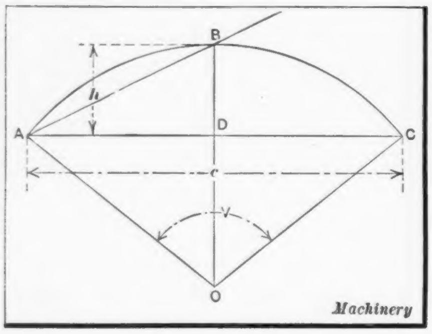


Diagram for finding Area of Segment of Circle

to furnish a convenient formula for calculating the area without employing trigonometric functions and which will give accurate results for both large and small angles. If the central angle does not exceed 160 degrees, the following formula can be used:

$$A = \frac{2}{3} h \sqrt{c^2 + 1.568 h^2}.$$

If accurate results are desired and the central angle is greater than 160 degrees, that is, if $\frac{h}{c}$ is greater than, say, 0.4, the following formula may be used, which gives very good results for all angles from 0 to 180 degrees; it is, however, far more difficult of application:

$$A = \frac{12 r^2 h \left[1 + 0.01824 \left(\frac{h}{c} \right)^3 \right]}{c + \sqrt{32 r h}} - \frac{c}{3} (r - h).$$

J. J.

TO FIND THE CENTER OF GRAVITY OF A SECTION

A. O. B.—Referring to the accompanying illustration, please show me how to calculate the center of gravity of the section.

A.—We note first that the figure is symmetrical about the axis AA', which passes through the center o of the circle in the upper part and is perpendicular to the base bc; in other words, if the paper were folded on the line AA', every point and line on one side would fall on corresponding points and lines on the other side; consequently, the center of gravity of the figure must lie on the line AA'. Now draw a line perpendicular to AA', the most convenient line in this case being BB', which coincides with the base line bc; this is an axis of reference. Divide the figure into elementary areas (rectangles, triangles, circles, etc.), whose areas and centers of gravity are easily found, and calculate the area of the entire figure, which we will call A. Denote the various elementary areas by A_1, A_2, A_3, etc., and the distances of their centers of gravity from BB' by y_1, y_2, y_3, etc.; also, let y = the distance of the point C, the center of gravity of the entire figure, from BB'. The distance y can then be readily found from the equation:

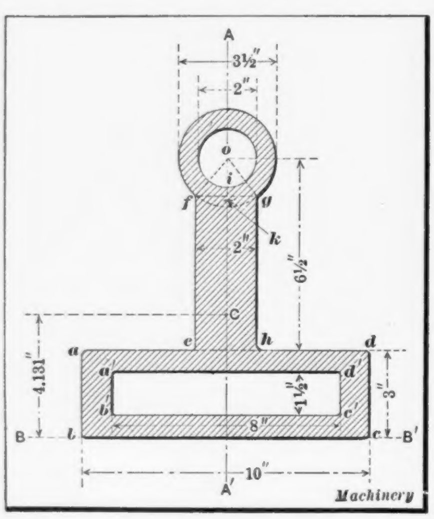


Figure whose Center of Gravity is to be determined

$$Ay = A_1y_1 + A_2y_2 + A_3y_3 + \text{etc.}$$

The different terms in this equation are the moments of the areas about the axis BB'. Referring now to the figure, the area A may be regarded as being made up of the hollow circular area minus the area of the segment fg plus the area of the rectangle $efgh$ plus the area of the hollow rectangle $abcd$, and these are now calculated as follows: Area of circular ring $= \frac{\pi}{4} \left[\left(3\frac{1}{2} \right)^2 - 2^2 \right] = 6.4795$ square inches. Sin $foi = \frac{fi}{of} = \frac{1}{1.75} = 0.57143$; hence, $foi = 34$ degrees 51 minutes, and $fog = 69$ degrees 42 minutes = 1.2165 radian. Area of segment $= \frac{1.75^2}{2} (1.2165 - 0.9379) = 0.4266$ square inch, since sin 69 degrees 42 minutes = 0.9379. Distance $oi = \sqrt{1.75^2 - 1^2} = 1.4361$ inch. Whence, $gh = 6.5 - 1.4361 = 5.0639$ inches, and area $efgh = 5.0639 \times 2 = 10.1278$ square inches. Area of hollow rectangle $= 10 \times 3 - 8 \times 1\frac{1}{2} = 18$ square inches. Consequently, $A = 6.4795 + 10.1278 + 18 - 0.4266 = 34.1807$ square inches. Distance of center of gravity of circular ring from $BB' = 6.5 + 3 = 9.5$ inches. Distance of center of gravity of segment from o is equal to the cube of the chord fg divided by twelve times the area of the segment $= \frac{2^3}{12 \times 0.4266} = 1.5627$ inch $= ok$, and distance of k from $BB' = 6.5 - 1.5627 + 3 = 7.9373$ inches. Distance of center of gravity of $efgh$ from $BB' = 5.0639 \div 2 + 3 = 5.5319$ inches. Distance of center of gravity of $abcd$ from $BB' = 3 \div 2 = 1.5$ inch. Substituting these values in the formula, $34.1807 y = 6.4795 \times 9.5 + 10.1278 \times 5.5319 + 18 \times 1.5 - 0.4266 \times 7.9373 = 141.1946$, and $y = 141.1946 \div 34.1807 = 4.131$ inches. Since the area of the segment was subtracted, its moment must be subtracted. J. J.

WEDGE REACTIONS

P. G. F.—What is the formula giving the relationship between the force P and the resistance Q in a wedge of the shape shown in the accompanying illustration (Fig. 1), friction being considered?

A.—A formula giving the relationship between the force P and resistance Q in Fig. 1 may be derived as follows: The force P may be divided into two components Q and Q_1, one acting normal to the inclined surface and one normal to the vertical surface of the wedge. If the parallelogram of forces is drawn, it is evident that, neglecting friction:

$$P = Q \sin \alpha$$
$$Q_1 = Q \cos \alpha$$

Now, if friction is considered, the forces resisting a downward movement of the wedge are composed of the vertical component of force Q, the vertical component of the frictional resistance due to the normal pressure of Q against the inclined side of the wedge, and the frictional resistance due to the pressure of force Q_1 against the vertical side of the wedge, or, expressed as a formula (the coefficient of friction being μ):

$$P = Q \sin \alpha + Q\mu \cos \alpha + Q_1\mu$$

But it has already been shown that:

$$Q_1 = Q \cos \alpha$$

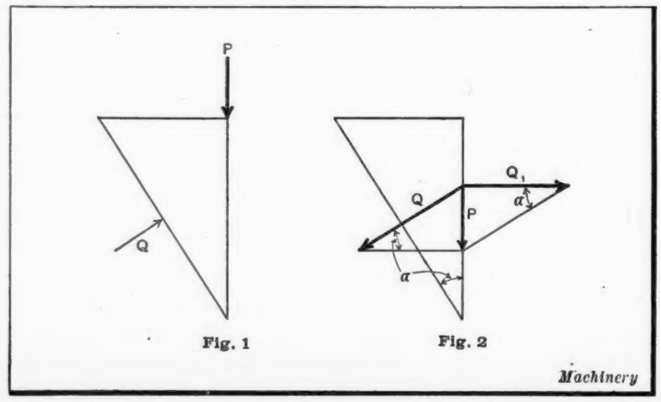
Hence, by inserting this value of Q_1 in the above formula:

$$P = Q \sin \alpha + Q\mu \cos \alpha + Q\mu \cos \alpha$$

This formula may be reduced to the simple form:

$$P = Q (2\mu \cos \alpha + \sin \alpha)$$

which may be considered the fundamental formula for a wedge of the type shown.



Wedge Reactions

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

HART-PARR SHELL BORING AND TURNING LATHE

The Hart-Parr lathe for turning and boring shells from 6- to 12-inch sizes is the result of an investigation conducted by the Hart-Parr Co., Charles City, Iowa, in preparing to start work on a shell contract. This is a single-purpose machine and its design combines several noteworthy features. Chief among these are the application of carefully fitted ball bearings in the head, and the extension of the spindle to form a boring-bar for the performance of internal operations, or a mandrel to support the shell for turning operations. The spindle bearings are fitted with great care so that alignment is obtained without the use of a tailstock, except where the shells are of exceptional length.

In taking up the manufacture of shells from 6- to 12-inch sizes, a preliminary study of the work made by the Hart-Parr Co., Charles City, Iowa, convinced its engineers that the boring and turning operations could be most advantageously handled on special machines designed with particular reference to the peculiar requirements of these operations. The machines shown in the illustrations which accompany this description represent the outcome of this investigation; they have a capacity for handling various types and sizes of shells from 6 to 12 inches in diameter, and the design has been worked out along lines which would make it easily modified to adapt the machine for various manufacturing operations in addition to the special class of work referred to. To meet the severe service conditions which exist in munition factories, these lathes have been heavily built to adapt them for continuous operation during a 24-hour working day. All lathe features not actually required for shell turning and boring have been eliminated to make the machines suitable for operation by relatively unskilled labor.

It will be seen that the headstock and bed are cast integral; and the headstock is of the box type with side walls that connect the front and rear bearings. The bed is provided with ribs of I-section which run crosswise to stiffen the construction as far as possible. The spindle is forged from high-carbon steel and extends out over the ways and carriage to form a boring-bar for the performance of interior operations on the shells, or an expanding arbor for supporting the work while turning operations are performed. The spindle is 6⅝ inches in diameter, and for all ordinary shell work it is depended upon to provide a sufficiently rigid support for the boring tools and formers; the same is true when the spindle is used as an expanding arbor to carry the shell, so that no tailstock is ordinarily required on the lathe. In the case of very long work, however, the use of a tailstock is required to provide outboard support.

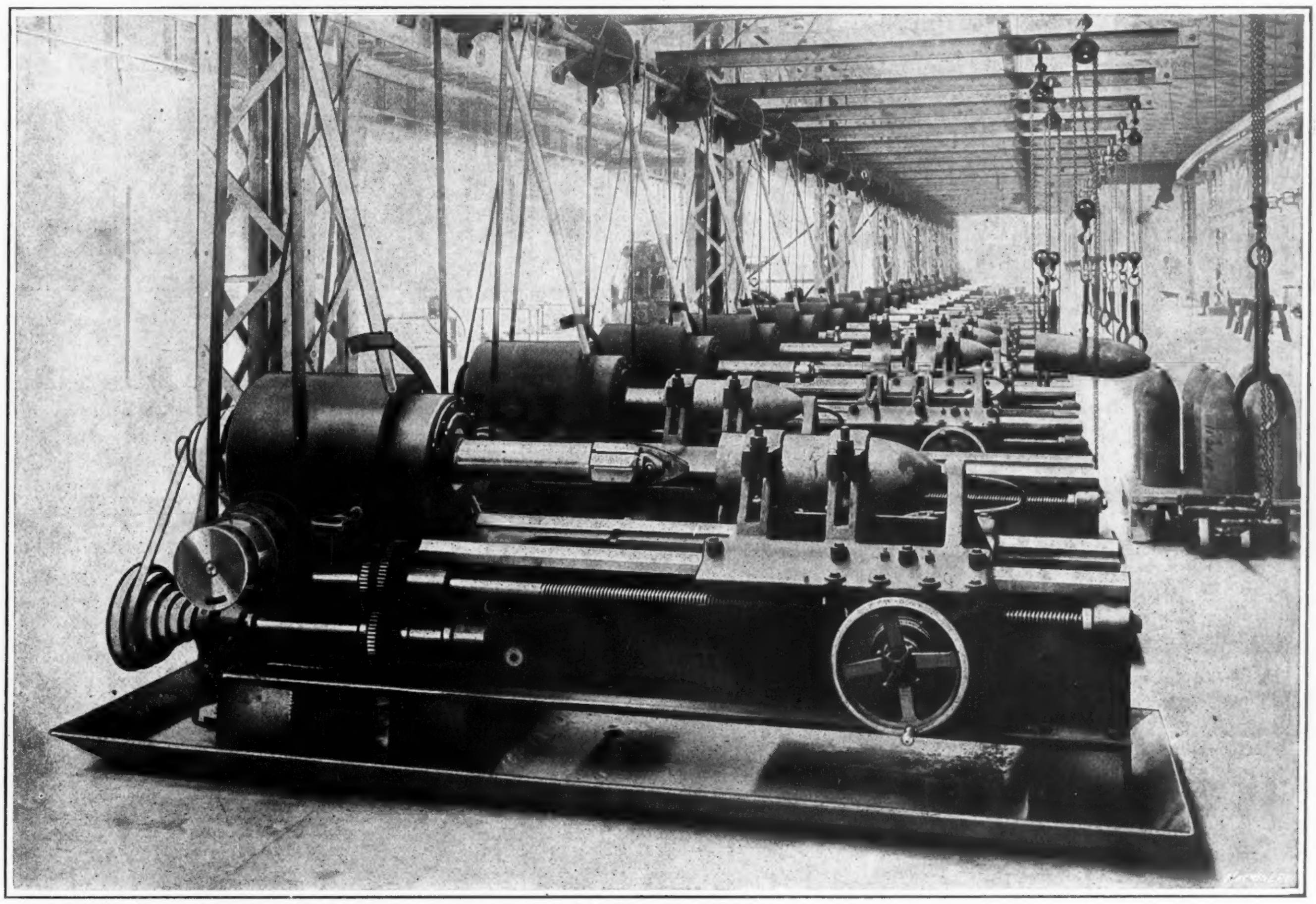


Fig. 1. Group of Hart-Parr Lathes for Shell Boring Operations; note Extension of Spindle and Method of holding Work

The spindle is mounted in combination radial and thrust ball bearings which are very accurately fitted; and owing to the liberal size and great durability of these bearings, permanence of spindle alignment is practically assured. Mounted upon the spindle there is a worm-wheel with a phosphor-bronze ring; and the worm which meshes with this wheel is mounted on the cone shaft, provision being made for clutching the worm directly to the shaft or driving through back-gears. With the four-step cone pulley on the machine, provision is made for eight changes of speed. With the high reduction obtained in this way the belt cone runs at high speed, enabling a 3-inch belt to provide ample power. Previous ex-

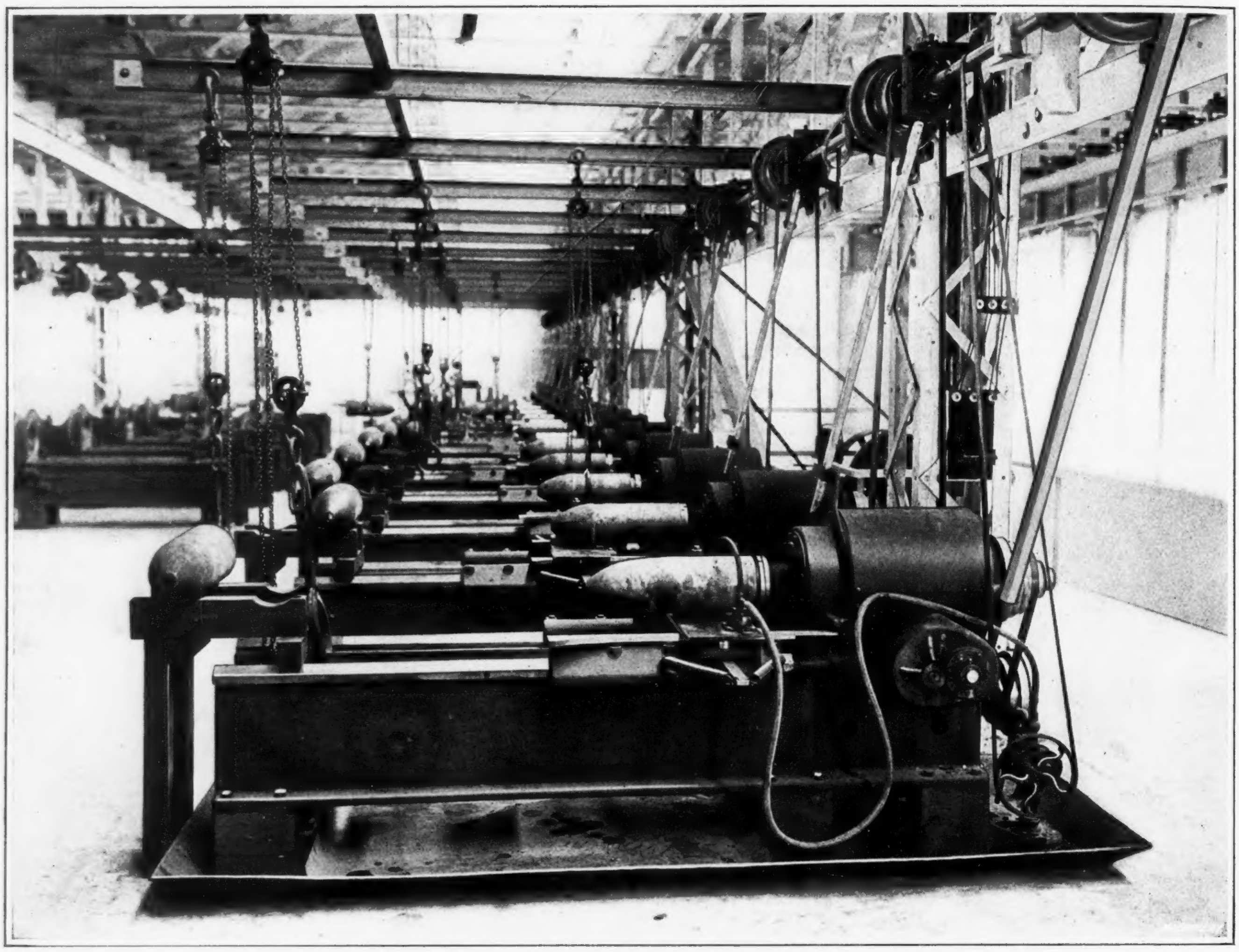


Fig. 2. Group of Hart-Parr Lathes tooled up for performance of Shell Turning Operation; note Arrangement of Forming Plate

perience with heavy machining operations led to the selection of this type of worm drive because of its steady action and freedom from chatter. The worm is quadruple threaded and mounted below the wheel; and the worm and wheel run in a liberal sized oil pocket which provides adequate protection against heating.

The feed mechanism is operated through spindle cone pulleys and provides six changes of feed. Both power feed and hand traverse are available and the mechanism is simply constructed. For the performance of outside turning operations, the tool and cross-slide are under control of a simple profiling cam which governs the turning operation over the entire length of the shell. For boring, the lathe is fitted with a heavy saddle carriage upon which the shell is clamped, and the carriage is fed up to the cutters secured in the end of the spindle. The stiffness of the machine and secure method of mounting provided for the work enables heavy boring and turning operations to be readily performed, including long forming cuts for finishing the outside of the nose and the taper on the inside of the shell. A quick return is provided for the carriage. For turning operations, a four-tool turret post is usually employed; or the lathe may be equipped with a turret tool-holder. The tools are made of ordinary square high-speed steel or steel shaped for round point cutters. The tools are held and clamped in this turret tool-holder in such a way that they are supported close to the work. The method of supporting is such that the heat generated by the cut is quickly conducted back from the tool point and dissipated.

In machining shells on this lathe the internal operations are performed first. The shell is clamped to the carriage and the first tool-head is mounted on the end of the spindle; this head carries a single-point tool which takes the roughing cut. By means of a special drift, this head is quickly removed from the spindle and a second head substituted which carries a

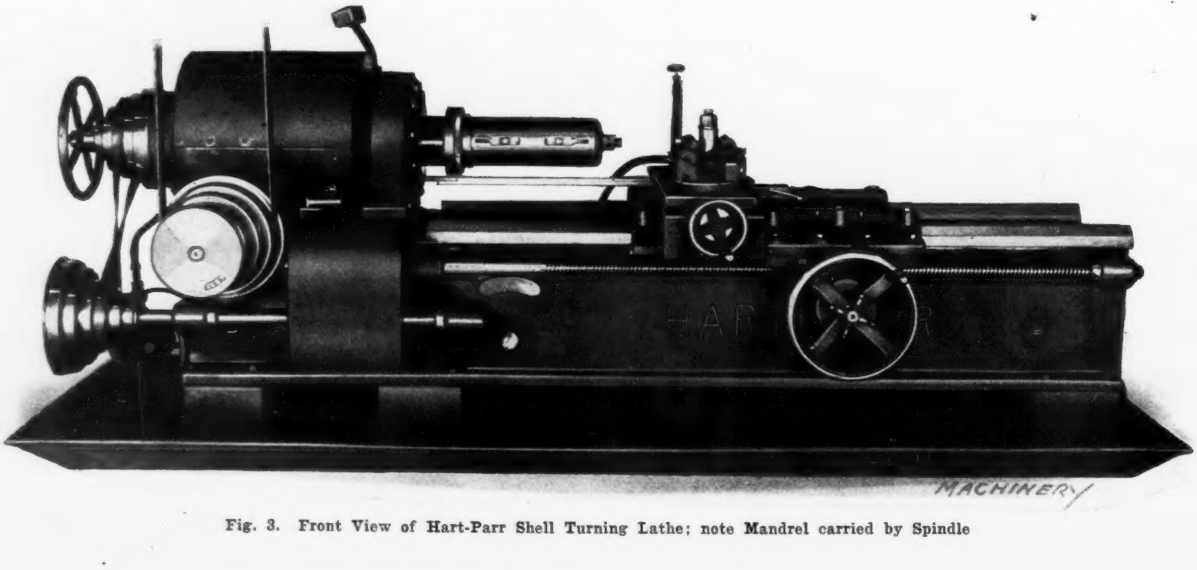


Fig. 3. Front View of Hart-Parr Shell Turning Lathe; note Mandrel carried by Spindle

rough-sizing reamer and rough arch-forming tool. The cut taken with this head finishes the inside diameter of the shell to size and rough-forms the arch. The next cutter-head carries finish-reaming and forming tools which complete the work on the arch. These three cuts complete the interior machining, and the same operations might provide for recessing and facing; but in case the forgings are very rough, one or two additional cuts are sometimes necessary. The shell is then removed and mounted on another Hart-Parr lathe equipped with an expanding mandrel on the spindle, on which the turning operation is performed. Turning, waving, and undercutting the band groove and boring, tapping and beveling the fuse opening could also be done on this machine if it were fitted with suitable attachments, but it will be found that this part of the work can be done more efficiently on a standard engine lathe.

The principal dimensions of the machine are as follows: length of bed, 10 feet, 6⅝ inches; depth of bed, 20⅞ inches; width of bed across vees, 24 inches; swing over bed, 26 inches; swing over carriage, 13¾ inches; width of vee, 2¾ inches; diameter of the front spindle bearing, 6.69 inches; diameter of the rear spindle bearing, 4.33 inches; width of the tool-slide, 12 inches; length of the carriage on the ways, 36 inches; available feed changes, 1/128, 1/64, 1/32, 3/64, 1/16 and 3/32 inch per revolution; available speeds for lineshaft speed of 682 R. P. M. when driving through back-gears, 8¼, 11¼, 15¼ and 20¾ revolutions per minute; available speeds when driving direct, 33, 45, 61 and 83 revolutions per minute; dimensions of lead-screw, 2 inches diameter by 1 inch lead; floor space occupied, 5 by 12 feet; and weight of machine, 10,000 pounds.

WARREN SHELL NOSE-TURNING MACHINE

In the February number of MACHINERY a description was published of the Warren lathe. Since that machine was placed on the market the Lombard Governor Co., Ashland, Mass., which is the builder of the Warren lathe, has developed a single-purpose machine for use in rough-turning the nose of 5-inch shell forgings. It will be seen that this machine has a heavy swinging tool-holder substituted in place of the turret; this tool-holder has two stations, one of which holds the cutting tools and the other a saddle that assists in putting the work into the chuck and removing it when finished. The turning is done by a series of tools which are stepped in to produce a form which roughly approximates the required shape of the shell nose; and the forging, that is carried in a collet, is fed up to these tools by oil under pressure, acting directly behind the end of the revolving spindle, thus eliminating all thrust friction.

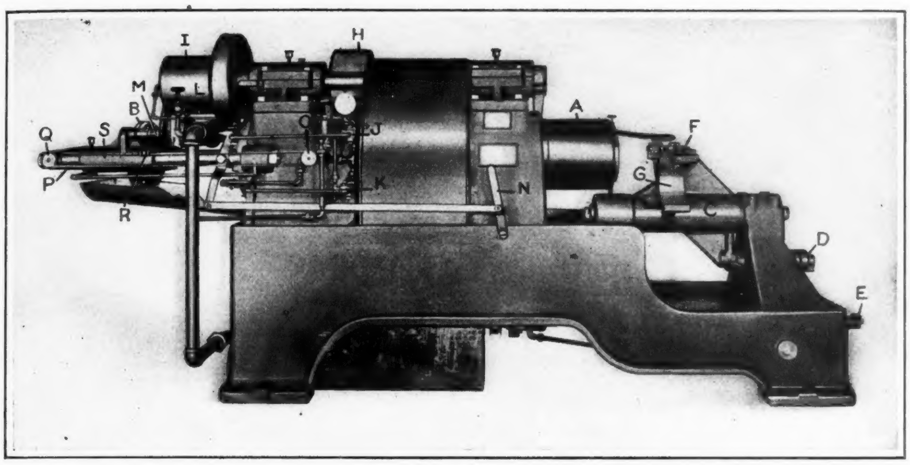


Fig. 1. Front View of Warren Lathe for rough-turning Nose of 5-inch Shell Forgings

The operation of the machine will be best understood by referring to the front view shown in Fig. 1. It will be seen that the end of the spindle is enlarged at *A* to provide for carrying a collet, the action of which is controlled by diaphragm *B*. Tool-holder *C* is provided with a locking pin *D*, operated by treadle *E* to provide for securing the tool-holder in either of its two positions. The turning tools are shown at *F;* and while loading a new forging into the collet, saddle *G* is swung up to provide a support for the forging from which it may easily be transferred to the collet. The machine is driven by pulley *H*, from which power is transmitted through double back-gears. Inside case *I* is a hydraulic clutch operated by valve *J;* and the chuck is controlled by valve *K*. An automatic reversing valve is shown at *L* which provides for

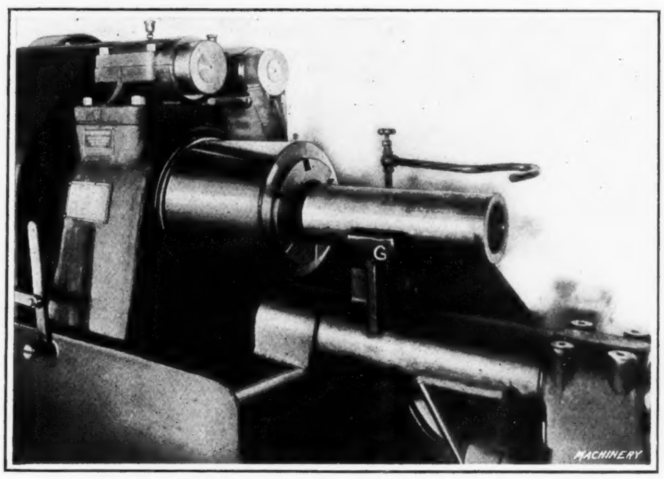


Fig. 2. Bracket G in Position to load Shell Forging into Collet

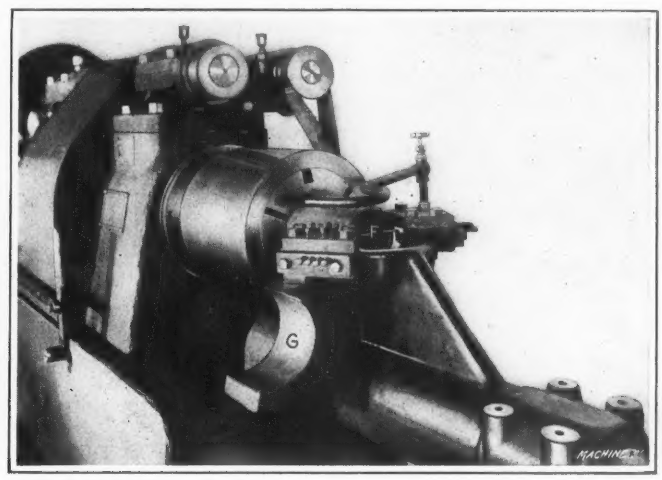


Fig. 3. Tools F at work roughing out Nose of Shell Forging

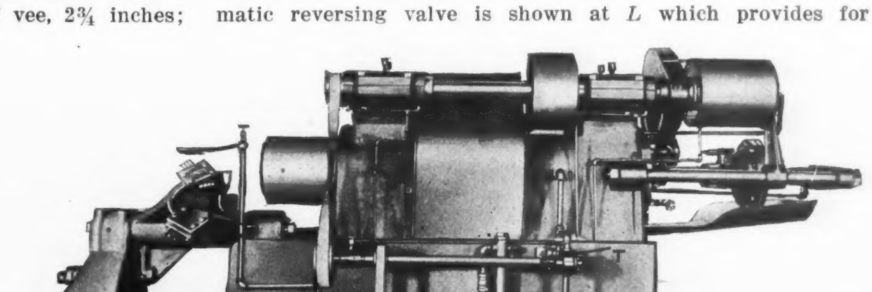


Fig. 4. Rear View of Warren Lathe showing Pumps for delivering Lubricant to Bearings and Tools

governing the forward and backward movements of the spindle, the forward movement being limited by thread stop *M*. The reversing valve *L* is controlled by handle *N*.

The speed at which the spindle moves forward, *i. e.*, the rate of feed, is controlled by an automatic needle valve *O* in such a way that it reduces the time required to complete the nose-turning operation by about 50 per cent. This is accomplished by placing a spiral grooved sheave upon the stem of this needle valve and mounting a small flexible steel cable *P* in the grooves of this sheave, the cable running back over idler pulley *Q*. At point *R* the cable is fastened to traveler *S* by an adjustable turnbuckle. This traveler moves back and forth with the spindle, and as the spindle is fed forward sheave *O* is rotated by the cable in such a manner that it gradually reduces the opening of the needle valve. Since this valve controls the rate at which the spindle is fed forward, it is obvious that the spindle starts to move at its maximum speed and this speed is gradually reduced until a minimum is reached at the forward limit of its travel.

The importance of this action will be appreciated when it is considered in connection with the arrangement of the turning tools *F*. There are eight of these tools, which are arranged in two rows and stepped in such a way that they roughly outline the nose of the shell. It will be evident that the holding power of the chuck is not unlimited, and the same applies to the driving power of the lathe. When only two tools are cutting, the rate at which the work is fed to the tools may properly be much greater than at later periods, when four, six or eight tools are at work; and it will be evident that the rate of feed must be decreased in direct proportion to the number of tools that are cutting in order to run at approximately the maximum driving capacity of the machine and holding capacity of the chuck at all times. This is the condition which is controlled automatically by needle valve *O*. If the rate of feed were constant it would be necessary to limit it to a value which would be permissible when all eight tools were cutting.

In the back view of the machine shown in Fig. 4, *T* is a pump which furnishes pressure for the hydraulic feed and supplies oil to all bearings, and *U* is a pump for delivering cutting compound to the tools. The oil is contained in a tank located in the base of the machine. It is stated that the first of these machines put in operation performed the rough nose-turning operation on 460 5-inch shell forgings in twenty-four hours.

GORTON FUSE RING MILLING MACHINE

The most noteworthy feature of the No. 8-C universal horizontal routing machine developed by the George Gorton Machine Co., Racine, Wis., for milling the vent and powder

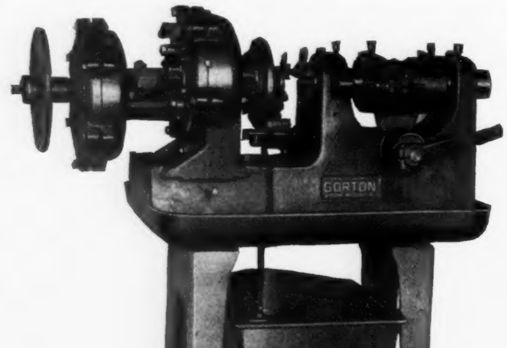


Fig. 1. Gorton No. 8-C Universal Fuse Ring Milling Machine

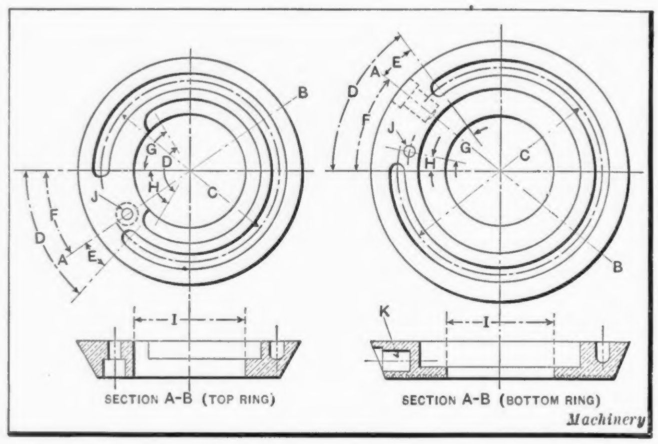
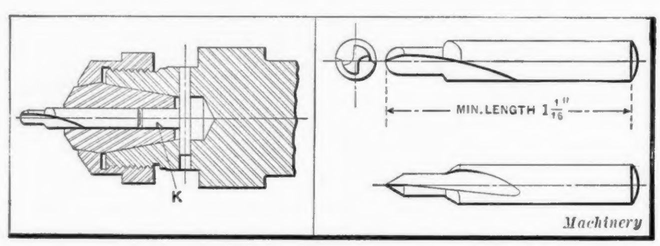


Fig. 2. Fuse Rings, showing Variations in Dimensions of Work which can be handled

grooves in fuse rings is that sufficient adjustment is provided to adapt the machine for working on rings for different types of fuses. The machine is shown in Fig. 1, and the amount of adjustment provided will be most readily understood by reference to Fig. 2. With fuse rings milled on the No. 8-C machine, *C* may be any dimension up to 4 inches; angle *D* may range from zero to 360 degrees; the gage holes may be located in any position on the top, bottom or side of the ring; and dimensions *E*, *F*, *G* and *H* may be of any magnitude called for by the drawings. Varying the diameter of the center hole *I* simply necessitates the use of a suitable faceplate.

The spindle of the machine is made of tool steel; it is hardened and ground and mounted in combination radial and thrust bearings. These bearings are housed in a sliding sleeve which is closed at the ends by felt washers and packed in grease. End play is taken up by a nut at the rear end of the spindle. The loose pulley is mounted independently of the spindle and carried by ball bearings. The spindle sleeve and



Figs. 3 and 4. Cross-section through Spindle Nose; and Type of Cutter used

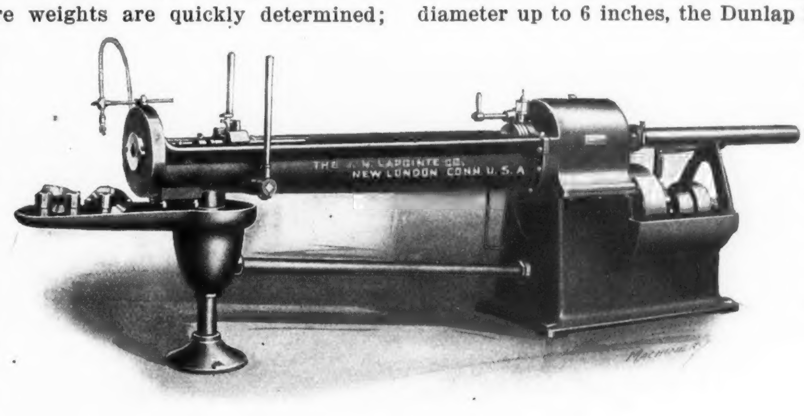
the sleeve which supports the loose pulley are clamped together by a yoke bored to fit the sleeves. This construction brings the belt pull between the front and rear bearings and avoids all tendency to throw the spindle out of line. Fig. 3 shows the spindle collet which holds the cutter in such a way that a fresh one may be easily substituted. The shank of the cutter bears against a spacing pin *K*, making it impossible for the tool to slip back from the work. If cutters with shanks of different diameters are required, it is merely necessary to use suitable collets, all of which are carried by the same spindle. The spindle should run at approximately 3200 revolutions per minute, the speed being varied slightly according to the nature of the work.

The groove in the fuse ring may be smoothly and accurately finished at a single cut, and the rate of production is from 25 to 30 rings per hour. The ring is held on a hardened and ground steel plate by a cam-actuated clamp; and the milling operation is controlled by hardened steel stops. A cutter lubricating system is furnished with the machine which consists of a pump, tank, strainer, relief valve, piping, and flexible nozzle. The machine may be mounted on legs, as shown in Fig. 1, or set directly upon a work bench; but where the latter method of mounting is employed a pump is not furnished. It is recommended that the cutter be run right-hand and the work left-hand, or *vice versa*, as this has been found to give the best finish at a single cut.

National-Chapman Combination Weighing Scale and Elevating Truck

NATIONAL-CHAPMAN SCALE ELEVATING TRUCK

One of the recent additions to the line of elevating trucks manufactured by the National Scale Co., 6 Mechanic St., Chicopee Falls, Mass., is a combination weighing scale and elevating truck, which is illustrated and described herewith. This truck is particularly useful in shipping and receiving departments or for taking inventories, where it is not only required to transfer material from one point to another but also to obtain accurate information as to its weight. Material loaded on wooden platforms can be weighed to obtain the gross weight, after which net and tare weights are quickly determined; and it will be evident that this does not in any way affect the advantages obtained from using the elevating truck. A so-called "Giant lift" is provided for raising heavy loads, and a safety handle release is furnished in addition to the foot-lever; a hydraulic check enables the heaviest loads to be lowered without the least jar. The axles are made of heat-treated steel and supported in Hyatt roller bearings. When transporting material on this truck, the loaded platform is supported by side bars so that no strain comes on the scale mechanism. This truck is made in four sizes having capacities for loads of 2500, 3500, 4000 and 4000 pounds.



No. 3-B Broaching Machine built by J. N. Lapointe Co.

J. N. LAPOINTE BROACHING MACHINE

The No. 3-B broaching machine which forms the subject of this description is a recent product of the J. N. Lapointe Co., New London, Conn., and supersedes the No. 3 machine formerly manufactured by this company. Two speed changes are provided which are fast and slow, and suitable for handling light and heavy work. Changes of speed can be made while the machine is either running or stopped; and all gears are enclosed and run in oil. A roller thrust bearing is mounted inside the gear-case and takes the pressure of the cut so that friction losses are reduced to a minimum and danger of heating the screw and nut is avoided. The driving screw is protected by a tube at the rear of the machine.

This broaching machine can be operated from the front or back, two operating levers being provided for the purpose. The oil pump has a capacity for delivering a copious flow of lubricant to the work at low pressure, a ½-inch flexible tube being provided to deliver the lubricant to the work. The machine is fitted with a duplex self-oiling clutch which is provided with a "non-burn" indestructible lagging. A reservoir is provided for lubricating the clutch, which has sufficient capacity so that it need only be filled once a month. Automatic stops control the length of stroke; these stops are of the spring and plunger type and may be adjusted without the use of wrenches. Means are provided for easily replacing any parts which are subject to wear.

The principal dimensions of this broaching machine are as follows: capacity to cut a 1½-inch keyway 10 inches long or to broach a 3-inch square hole 6 inches long; size of driving pulley, 18 inches in diameter by 5¼ inches face width; speed of screw on low gear, 3 feet per minute; speed of screw on high gear, 5½ feet per minute; dimensions of driving screw, 2¾ inches diameter by 54 inches maximum stroke, 2 pitch; floor space occupied, 16½ by 2½ feet; and net weight of machine, 3400 pounds.

DUNLAP SHELL LATHE

To meet the requirements of turning shell forgings up to 10 inches in diameter and for boring shells having an inside diameter up to 6 inches, the Dunlap Mfg. Co., Columbus, Ohio, has recently placed on the market the "Columbus" 21-inch back-geared engine lathe which is illustrated and described herewith. This is a heavy-duty single-purpose machine, and in addition to its application on shell work it is suitable for any class of general manufacturing where there are a large number of duplicate parts to be turned and bored. As the machine is intended for manufacturing, it is only provided with a sufficient range of speeds to cover working diameters from 2 to 10 inches; and changes of feed are provided ranging from 0.012 to 0.112 inch per revolution.

The bed is made of semi-steel and provided with five cross-girders to give the required stiffness. The vees have an included angle of 90 degrees, and the rear end of the bed is cut away to allow overhang or quick removal of the tailstock. At the back of the bed there is a pad to which a forming attachment or taper turning attachment may be secured. The headstock has ring-oiled bearings and is driven by a 6-inch belt

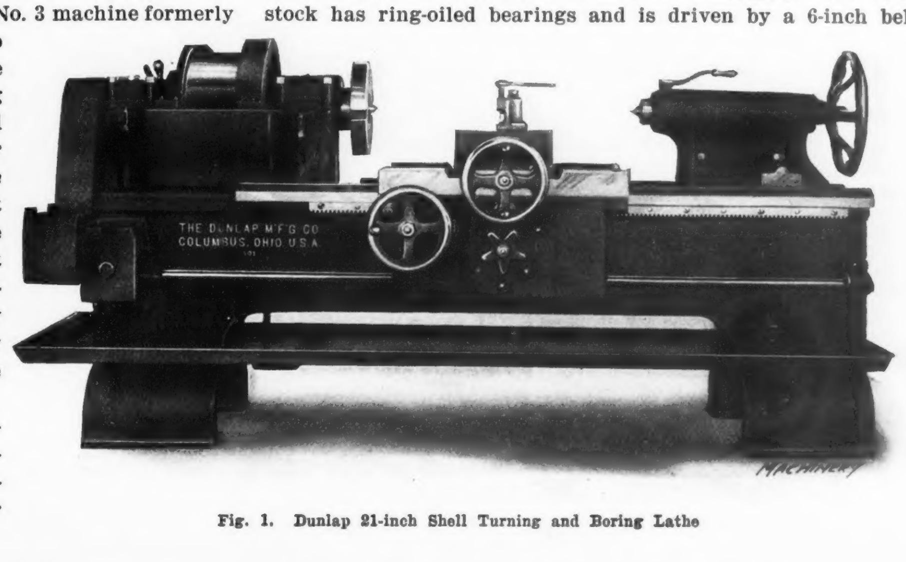


Fig. 1. Dunlap 21-inch Shell Turning and Boring Lathe

which provides sufficient power for driving high-speed steel tools to the limit of their cutting capacity. The ratio of the back-gears is 11 to 1. The spindle is machined from a steel forging and has a hole $1\frac{1}{2}$ inch in diameter bored through it. The spindle thrust is taken by a bearing composed of steel and bronze collars.

The carriage is constructed of semi-steel and has a bearing on the bed 30 inches in length; the over-all width of the carriage is 26 inches and the tool-rest is 12 inches wide. The apron is of the double-wall box type; all shafts are supported at both ends and the gears are made of steel. Positive geared power longitudinal feed is provided, with automatic stops for governing the dimensions of duplicate work. Power is transmitted from the spindle to the gear-box by a roller chain. The seven rates of feed provided are 0.012, 0.018, 0.027, 0.037, 0.052, 0.074 and 0.112 inch per revolution.

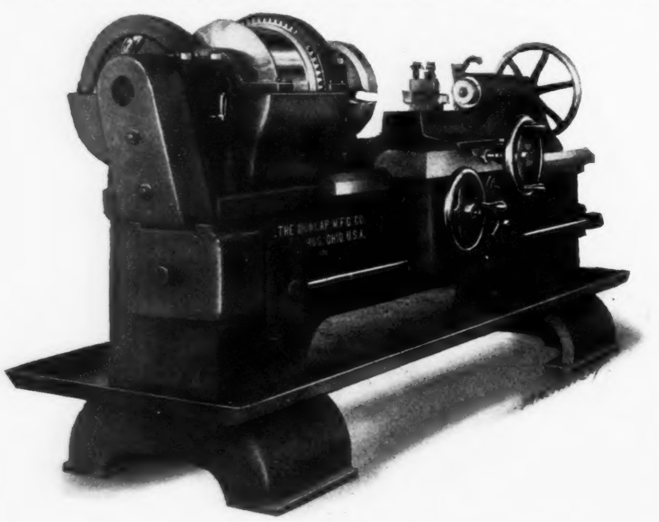


Fig. 2. Partial End View of Dunlap Lathe shown in Fig. 1

The principal dimensions of the machine are as follows: swing over bed, 21 inches; swing over carriage, 14 inches; swing over tool-rest, 13 inches; height of centers from floor, 40 inches; maximum capacity between centers, 37 inches; maximum distance between centers with tailstock overhanging, 44 inches; and approximate weight, 6000 pounds. The standard equipment furnished includes a toolpost, plain toolrest, two No. 5 Morse taper centers, a 12-inch faceplate, and the necessary wrenches for making all adjustments.

WILL-BURT ADJUSTABLE VISE

The "Carpenter" vise, which is a recent product of the Will-Burt Co., Orrville, Ohio, is so constructed that it may be used in either a horizontal or vertical position; and the vise swings freely on the base so that it may be used in any position which is most convenient for the workman. When the jaws are tightened by the screw, this also clamps the vise in place on its base. The construction of this tool will be readily understood by reference to Figs. 1 and 2, which show it in the vertical and horizontal positions, respectively.

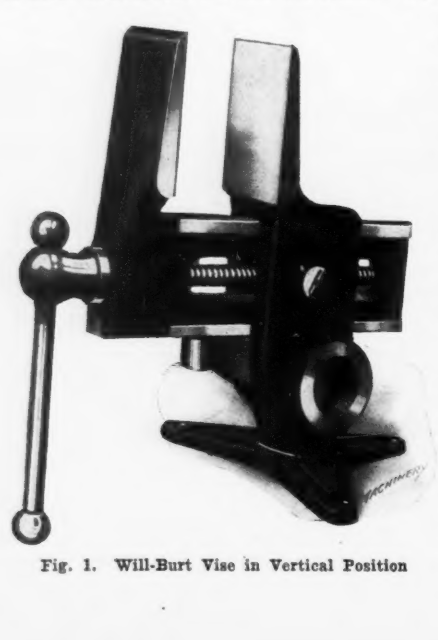


Fig. 1. Will-Burt Vise in Vertical Position

The vise may be equipped with a pair of auxiliary jaws for holding a carpenter's saw in position for filing. These jaws slip over the vise jaws and are ready for instant use without adjustment. They have a wide contact bearing on the saw blade so that all chatter is eliminated.

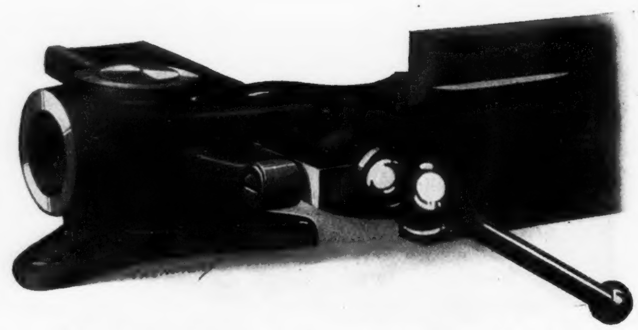


Fig. 2. Will-Burt Vise holding Work in Horizontal Position

BEIGHLEE ELECTRIC RECORDING PYROMETER

The two most important features of the instrument made by the Beighlee Electric Co., Cleveland, Ohio, for recording the temperatures of one, three, six, nine or twelve thermo-couples on one chart, are the elimination of ink as the recording medium and the maintenance of accuracy of indications independent of temperature fluctuations at the cold junction, by means of a self-contained, automatic Wheatstone bridge system. The records are produced by an electric spark and are entirely separate for each thermocouple. The adjustment of the Wheatstone bridge system is always under full control of the operator and can be easily regulated by "test points," calibrated for each instrument. The recorder contains a self-winding electric clock, so that no winding by the operator is necessary. The internal resistance of

Fig. 1. Electric Recording Instrument which burns Record on Chart

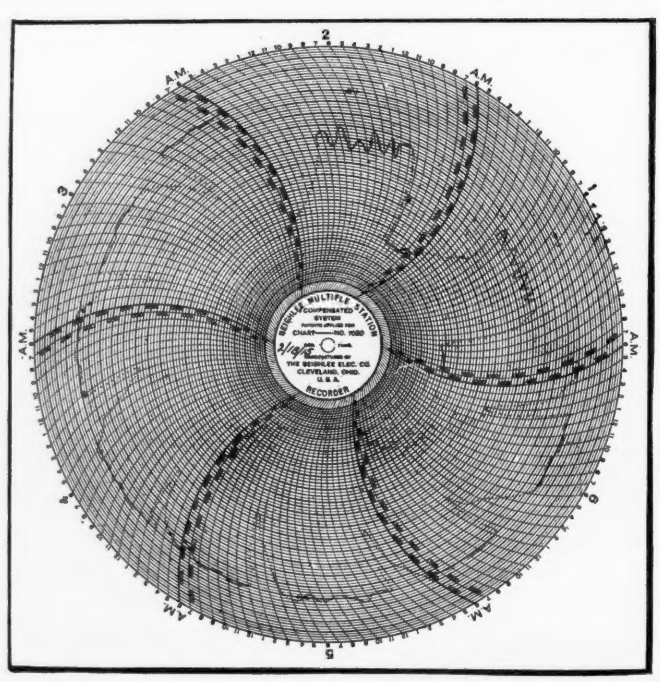


Fig. 2. Chart made on Beighlee Recording Instrument shown in Fig. 1

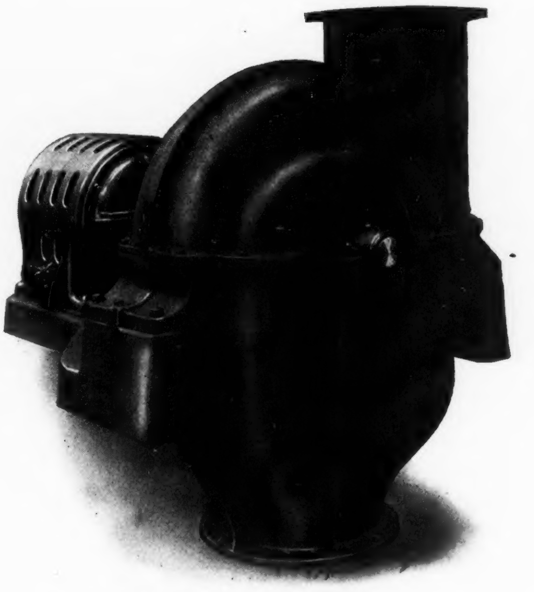


Fig. 1. Ingersoll-Rand Low-pressure Turbo-blower

these recorders is about 750 ohms, so that the accuracy of indications is not influenced by the difference in length of connecting wires of the various thermo-couples applied. These recorders are being manufactured by the Beighlee Electric Co., Cleveland, Ohio, and Herman A. Holz, 50 Church St., New York City, has the sales agency.

INGERSOLL-RAND TURBO-BLOWER

The Ingersoll-Rand Co., 11 Broadway, New York City, has added to its line of turbo-compressors and blowers a low-

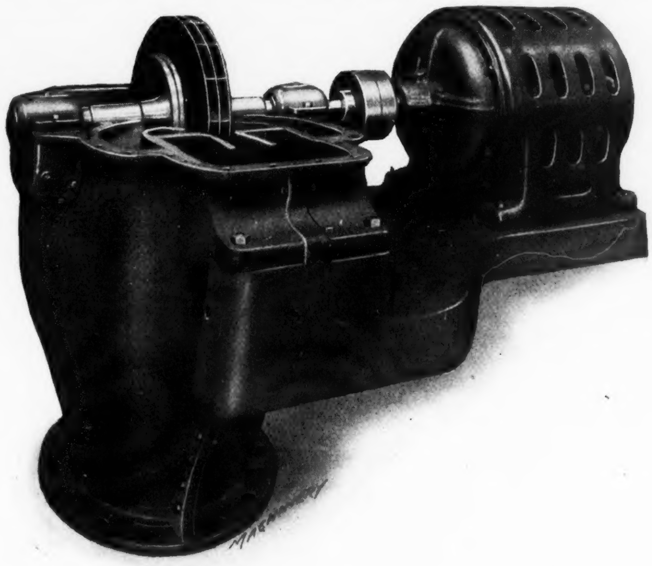


Fig. 2. Turbo-blower shown in Fig. 1 with Casing removed

pressure unit capable of handling volumes of air ranging from 3000 to 35,000 cubic feet per minute at a pressure of from 1 to 2½ pounds per square inch. These blowers are suitable for a variety of purposes, among which may be mentioned atomizing oil for oil burners, supplying the air blast to heating and annealing furnaces of various kinds, operating ventilating and pneumatic conveying systems, and supplying the blast for foundry cupolas. They are of the single-stage, double-flow type and may be driven by electric motor, steam turbine, or water wheel, electric drive being generally employed for the classes of service referred to. Operating at high speed makes it possible to connect the blower direct to the driving motor, and it is stated that constant pressure is maintained while delivering any volume from zero to the maximum capacity.

The four-bearing type of construction employed in all turbo-machines built by the Ingersoll-Rand Co. is employed on the present turbo-blower. The casing is split horizontally to facilitate installation and subsequent inspection, the assembled casing being doweled and bolted to a heavy sub-base which ordinarily serves as a support for both the blower and driving member. The whole unit is compactly built so that the floor space occupied is relatively small. The impeller is of the enclosed double-flow type, and the wheel is machined from a steel forging. The vanes and covers are made of pressed steel and are riveted in place, all rivet heads being driven flush. In testing the machine, the impellers are over-speeded, so that correct balance, strength and freedom from vibration are insured when running under normal conditions. The impellers are keyed to a heat-treated forged steel shaft, and a labyrinth packing is employed to prevent leakage. The use of flexible couplings between the blower and driving unit is standard Ingersoll-Rand practice. The intake opening is at the bottom and the discharge opening at the top. The flow of air from this type of blower is said to be absolutely uniform, without any tendency to develop "pulsation." There are no rubbing surfaces in the machine, and this precludes the necessity of making adjustment to take up wear.

WILLIAMS-WHITE RIFLE BARREL MILL

For use in rolling rifle barrels to approximately the required shape, Williams, White & Co., Moline, Ill., are building rolling mills of the types shown in the accompanying illustrations.

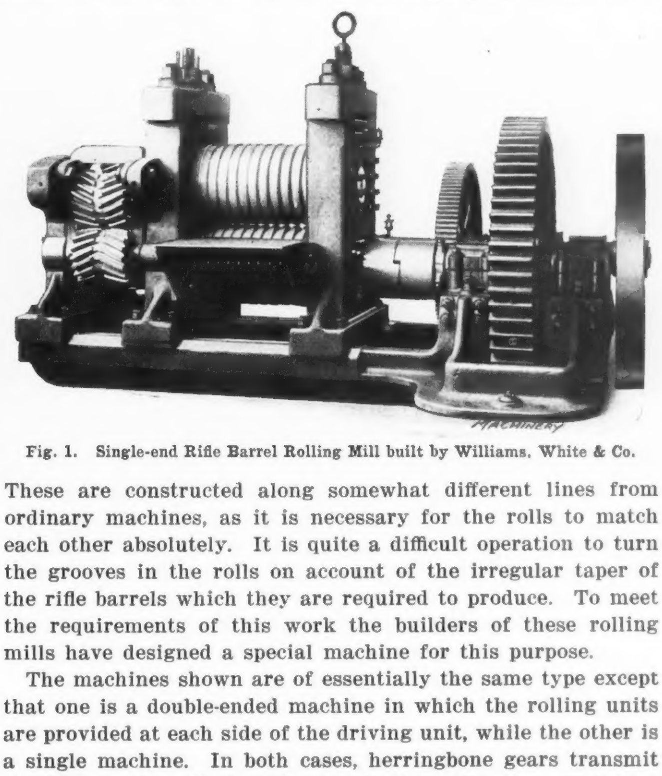


Fig. 1. Single-end Rifle Barrel Rolling Mill built by Williams, White & Co.

These are constructed along somewhat different lines from ordinary machines, as it is necessary for the rolls to match each other absolutely. It is quite a difficult operation to turn the grooves in the rolls on account of the irregular taper of the rifle barrels which they are required to produce. To meet the requirements of this work the builders of these rolling mills have designed a special machine for this purpose.

The machines shown are of essentially the same type except that one is a double-ended machine in which the rolling units are provided at each side of the driving unit, while the other is a single machine. In both cases, herringbone gears transmit the drive to the rolls in order to eliminate vibration. This type of machine is used in the factories of the Remington Arms Co. at Eddystone, Pa., Bridgeport, Conn., and Ilion, N. Y.

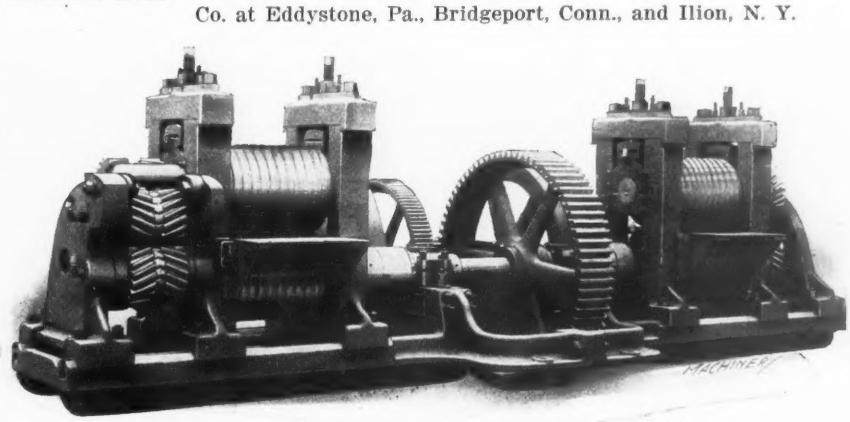
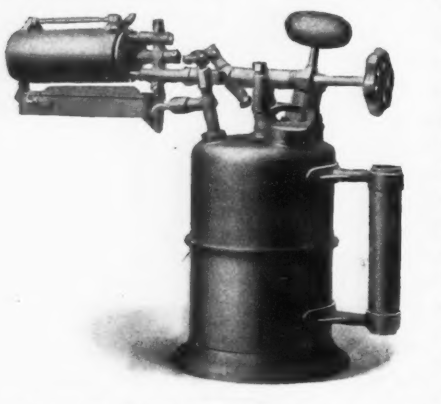


Fig. 2. Double-end Williams-White Rifle Barrel Rolling Mill

VOLCANO KEROSENE AND GASOLINE TORCH

The latest addition to the line of "Volcano" blow-torches made by the Volcano Torch & Mfg. Co., Erie, Pa., is a combination kerosene and gasoline torch shown in the accompanying illustration. As its name implies, either kerosene or gasoline may be burned in this torch, and it has the capacity for raising the temperature of a solid 2-inch shaft to a red heat in from eight to ten minutes. It will produce a flame from 12 to 14 inches in length. One of the features of this torch is that it enables kerosene to be used in places where insurance regulations prohibit the use of gasoline. The position of the burner can be adjusted to any angle that is most suitable for the work, and this adjustment is easily made while the torch is in use.

The pre-heating cup has a circular adjustment in a horizontal plane, so that it can be swung a sufficient distance toward the tank or main body of the torch to receive its fuel supply from a small valve situated at the top of the tank. A snuffer or extinguishing blade is located immediately above the starting cup for the purpose of extinguishing the flame when the main burner is hot enough to be ready for work, thereby eliminating interference of the combustion in the starting cup with combustion of the main burner. One-half the casing around the main burner can be swung open to permit the flame from the starting cup to have direct contact with the main burner, thus reducing the length of time required for pre-heating. These torches are made in two types, known as Nos. 10-A and 10-B. They have a capacity for holding ½ gallon of fuel oil.



Volcano Blow-torch in which either Gasoline or Kerosene can be burned

NEWMAN TURRET HEADS

The Newman Mfg. Co., 717 Sycamore St., Cincinnati, Ohio, is now making turret heads for use on lathes and drill presses, which provide for rapidly bringing into action any sequence of tools which may be required. Fig. 1 shows the drill head which holds four tools. This head is held in place by a locking mechanism, and may be quickly changed to bring successive tools into the operating position. The sleeve on the head is attached to the quill surrounding the drill press spindle, and provides for locating the head at the proper height. The only part of the mechanism which revolves is the tool in the operating position. These drill press turret heads are made in two sizes for No. 2 and No. 4 taper shanks, or they may be made to hold straight shanks if required.

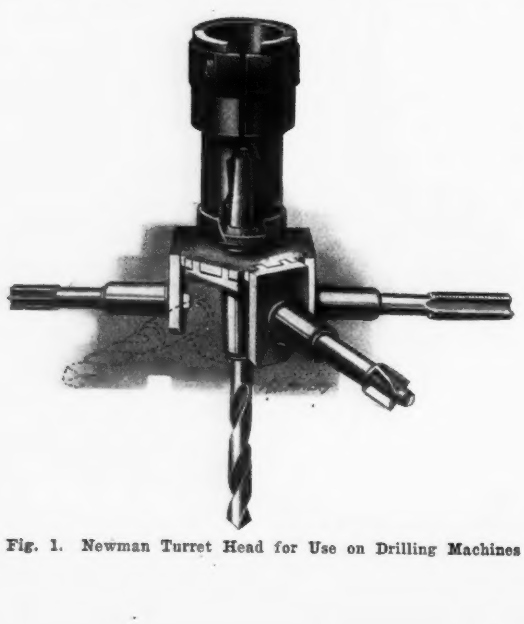


Fig. 1. Newman Turret Head for Use on Drilling Machines

Fig. 2 shows the lathe turret toolpost which is attached to the outside of the tailstock spindle and provides for using a sequence of five tools. This is obviously a great convenience where the work is of such character that it is necessary to perform turning, facing, boring, reaming and tapping operations or any similar sequence of five operations. Only a few moments are required to attach or detach this toolpost. It is made in three sizes which are 6, 7 and 8 inches in diameter, and suitable for use on a great variety of sizes and types of lathes. A similar turret toolpost is made to clamp to the carriage T-slot.

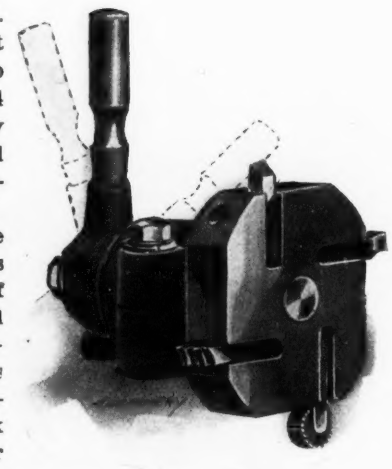
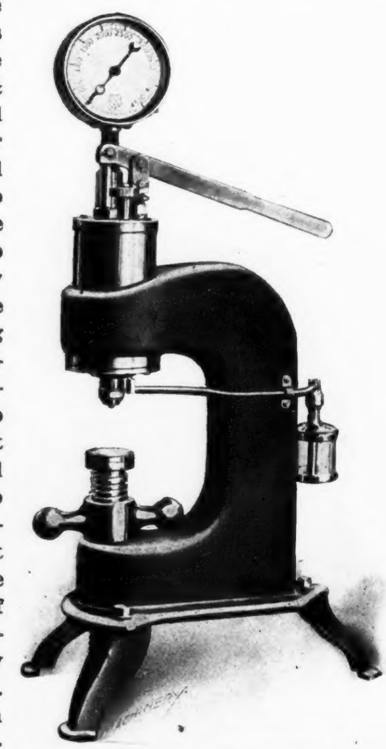


Fig. 2. Newman Lathe Tailstock Turret

PITTSBURG HARDNESS TESTING MACHINE

The Brinell method of testing the hardness of metals is too well known to require explanation here, but readers of MACHINERY will be interested in two types of machines built by the Pittsburg Instrument & Machine Co., 236 Third Ave., Pittsburg, Pa., for conducting the Brinell hardness test. Two types of machines are built, one of which is so heavy that it is only adapted for use where it is practicable to bring the test bars to the machine. To meet the requirements of those who want an instrument which may be carried about the factory so that tests may be conducted at the point where materials are used, a lighter form of machine has been developed which can readily be carried by one man. This machine is shown in the accompanying illustration; it is operated by hydraulic pressure and is suitable for testing structural steel, rails, automobile parts and similar products on which it is desired to ascertain the effect of hardening and annealing operations.



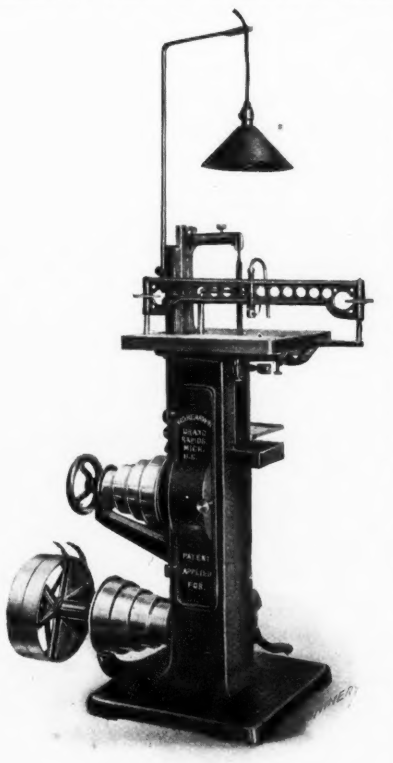
Pittsburg Hardness Testing Machine which operates on the Brinell Principle

LEWIS-SHEPARD ELEVATING TRUCK

The most important features of design of the "Hi-lift" elevating truck recently placed on the market by the Lewis-Shepard Co., 262-280 Dover St., Boston, Mass., are the provision for elevating the load 2½ or 3 inches (according to the size of the truck) by purely mechanical means, and the fact that all parts of the truck are made of cast steel with the exception of the wheels which are of gray iron. The system of levers by which the truck is elevated is so arranged that imparting a force of 85 pounds to the lifting lever and giving it four strokes provides for raising a load of 3000 pounds to the full

"Hi-lift" Elevating Truck made by Lewis-Shepard Co.

height; and by imparting six strokes with a force of 110 pounds, a load of 5500 pounds may be raised to the full height. The high-lift feature is important because it assures the wooden skid clearing all ordinary inequalities of floor level which are likely to be met with in transferring material through a factory. Another feature of the truck is that the handle by which it is drawn is placed at a sufficient height from the floor so that very little of the force exerted by the trucker is wasted. The truck is provided with a release check so that heavy loads may be lowered without the least shock or vibration. These elevating trucks are made in eight different sizes; they weigh from 305 pounds up (according to size) and have capacities for loads ranging from 2500 to 5500 pounds.



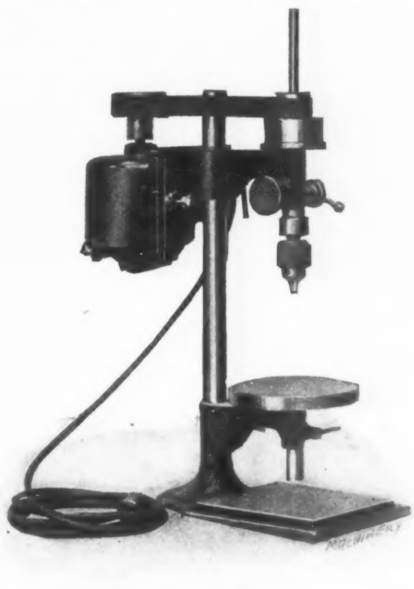
Improved Rearwin Die Filing Machine

REARWIN DIE FILING MACHINE

In the January, 1916, number of MACHINERY mention was made of a die filing machine which W. D. Rearwin, 341 Mill Ave., N. W., Grand Rapids, Mich., had just placed upon the market at that time. The accompanying illustration shows a die filing machine which is of essentially the same design, except that it is provided with a work-holding clamp, while it was necessary for the operator to hold the die block by hand while filing it on the original machine. Reference to the illustration will make it evident that the clamp arm is provided with adjusting screws at each end so that its height from the table may be quickly adjusted to accommodate the work, after which it is an easy matter to clamp the work by means of the screw located at the center of the arm. It will be seen that the provision of this clamping arm makes the operation of the machine much more convenient.

CRANE BENCH DRILL

The motor-driven ball bearing bench drill shown in the accompanying illustration is manufactured by H. G. Crane, 226 Cypress St., Brookline, Mass. The spindle of this tool is mounted in such a way that it is relieved of all belt strain, and the spindle runs in double annular ball bearings. A thumb-screw adjustment provides for regulating the belt tension. The motor is of the Holtzer-Cabot vertical type; it runs at 1750 R. P. M. and may be furnished for operation on 110 or 220 volt circuits, either alternating or direct current. It will be seen that a control switch is located at the side of the motor, and a 10-foot cord and connection plug form part of the regular equipment. The head and motor may be lowered and swung through an angle of 180 degrees to allow the drill to clear the base.



H. G. Crane Motor-driven Ball-bearing Bench Drill

The principal dimensions are as follows: capacity for driving drills up to 1/4 inch in diameter; maximum feed of spindle, 2 5/8 inches; maximum distance from chuck to round table, 8 inches; maximum distance from chuck to base, 13 1/2 inches; size of round table, 6 5/8 inches in diameter; size of base, 6 3/4 inches by 7 1/2 inches; distance from column to spindle, 4 3/8 inches; total height, 22 inches; range of spindle speeds, from 900 to 3000 R. P. M.; and weight of tool, 60 pounds.

MULTI-METAL DUST HOOD AND BABBITTING MASK

The Multi-Metal Separating Screen Co., 68-72 E. 131st St., New York City, is now manufacturing the babbitting mask and dust hood, shown in Figs. 1 and 2, respectively. The dust hood is made of light fabric which is fitted over a frame that keeps the hood away from the face of the wearer. The hood drops down to the neck and can be tightened by means of a draw string. To give the wearer a clear view while wearing the hood, a window is provided which may be made of trans-

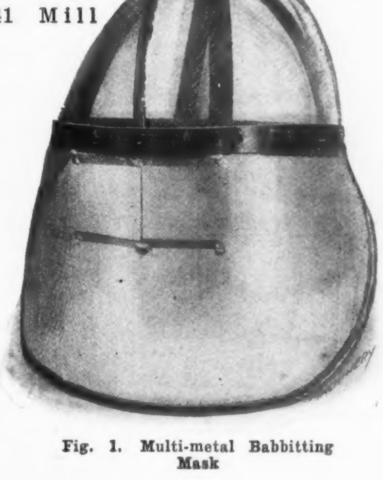


Fig. 1. Multi-metal Babbitting Mask

Fig. 2. Multi-metal Dust Hood for Sand-blast Operator

parent celluloid, mica or glass; and ventilation is provided by six screened openings in the top of the hood and four in the skirt. There is always a free circulation of air through these openings, so that the hood is cool and comfortable to wear. An arrangement of multiple screens provides for excluding dust, so that the hood may be used in place of a respirator and goggles. It is intended for the use of sandblast operators, and for men whose employment takes them into places filled with lamp-black dust, lead dust, and other poisonous materials. The weight of the hood is 13 ounces.

The babbitting mask shown in Fig. 1 is built over the same form of head frame that is used to support the dust hood. The mask is made in three pieces of wire gauze, two of which are hemispherical in shape and form the cap, these two members being joined together by a web which serves to stiffen this part of the mask. The third part consists of an "apron" which drops to a point considerably below the chin of the wearer and extends around almost from ear to ear, so that ample protection is provided against injury from metal which may be splashed out of the molds. Additional protection for the eyes is afforded by two square pieces of heat-treated glass carried inside the screen. The weight of the mask is 14 ounces.

SHELL TURNING LATHE

For use in turning and facing the back end of 12-inch shells, the American Machine Tool Co., Hackettstown, N. J., has recently placed on the market a heavy-duty 24-inch single-purpose lathe. While the machine was built to meet the requirements of this particular class of work, changes could easily be made to adapt it for a variety of other special manufacturing operations or for general lathe work. It will be noticed that the headstock is of the English type with the gears placed at the front. The lever at the top of the head operates a pair of sliding gears carried on the feathered sleeve attached to the cone pulley, two changes of speed being provided in this way. The spindle is made from a high-carbon steel forging; it is 5½ inches in diameter and has a 2⅛-inch hole bored through it. The nose of the spindle is bored No. 6 Morse taper. The spindle bearings are bronze-bushed, and the end thrust is

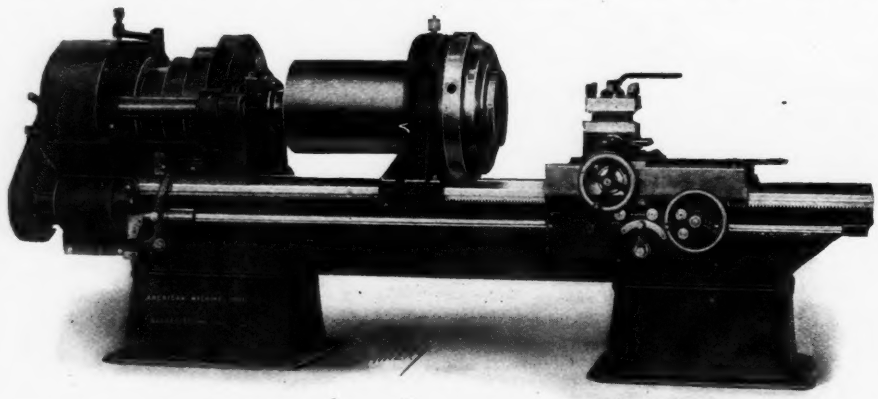


Fig. 1. American Machine Tool Co.'s 24-inch Shell Lathe equipped with Steadyrest and Chuck

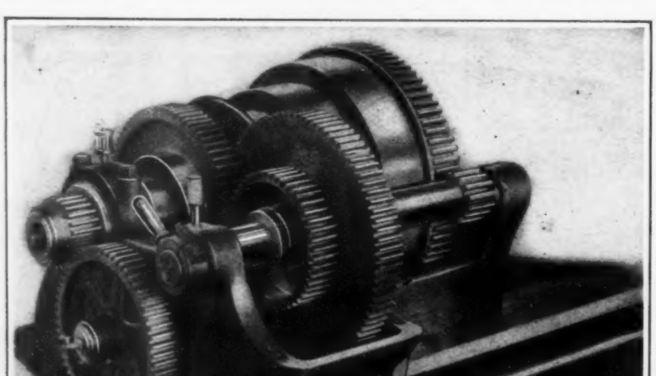


Fig. 2. Close View of Head and Gear-box with Gear Guards removed

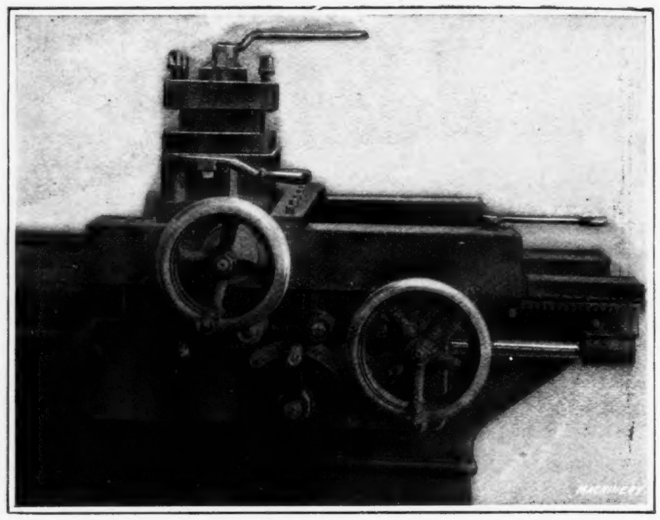


Fig. 3. Close View of Apron, showing Arrangement of Feed Reverse Lever

taken by a standard ball bearing. The cone pulley is turned both inside and outside to insure obtaining perfect running balance; and a hand-operated plunger provides for locking the large gear to the cone pulley.

The gear-box is of simple construction, a feature of the design being that no clutch is employed. All gears run in oil. The hand-lever is easily moved to any of the four positions on the quadrant; this lever moves a key which provides for engaging the required gear. Hardened steel rings placed between the gears cause the key to be depressed below the surface of the shaft to pass from one set of gears to another and a spring under the key forces it back into place in the keyway as soon as it has passed from under the ring. Four changes of feed are provided, *viz.*, 0.015, 0.023, 0.033 and 0.063 inch per revolution of the spindle.

The bed is of the English type with a flat bearing at the back and a small supplementary vee for lathes where a tailstock is required. The vee at the front of the bed is planed to angles of 22 and 68 degrees. The carriage has its bearing on the inner side of the vee directly in line with the thrust of the tools. The apron is constructed with a back plate so that provision is made for supporting the gear shafts at both ends. Throwing the lever from the position marked "neutral" to the position marked "right" moves the carriage to the right; and the carriage can be moved in the opposite direction by throwing the lever to the position marked "left." The power cross-feed is operated by throwing the same lever to the neutral position and then pushing in the knob on the cross-feed shaft as far as possible, which engages the cross-feed gears and disengages the rack and pinion. The lever on the apron is then thrown one way or the other from the neutral position according to the direction in which the feed movement is required. Pulling out the knob on the cross-feed shaft disengages the gears.

The principal dimensions of the machine are as follows: diameter of spindle, 5½ inches; length of spindle, 3 feet, 7⅝ inches; diameter of hole through spindle, 2⅛ inches; size of front spindle bearing, 5 inches in diameter by 5 13/16 inches long; size of rear spindle bearing, 3⅝ inches in diameter by 4¼ inches long; length of bed, 11 feet; width of carriage bearing on ways, 31 inches; size of turret, 8 inches square; floor space occupied, 3 feet by 11 feet, 6 inches; and net weight of machine complete with steadyrest, chuck and countershaft,

7570 pounds. The factory of the American Machine Tool Co. is at Hackettstown, N. J., and sales offices are maintained at 50 Church St., New York City.

HIMOFF SINGLE-PURPOSE LATHES

The single-purpose manufacturing lathes illustrated and described herewith are built in 16- and 20-inch sizes by the Himoff Machine Co., Inc., 128 Mott St., New York City. It will be seen that the machine shown in Fig. 1 is equipped with a two-step cone pulley, and this machine is furnished with a back-geared drive. The machine shown in Fig. 2 has a single pulley mounted direct on the spindle, and this machine is arranged to be driven at a speed which is suitable for the class of work for which the lathe is used. With the exception of the drive, both machines are of the same design.

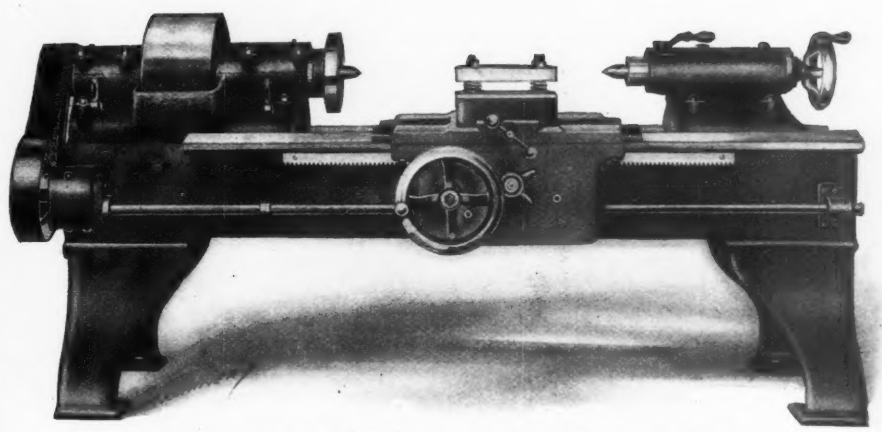


Fig. 2. Himoff Lathe equipped with a Single Pulley on the Spindle

The principal dimensions of the 16-inch machines are as follows: length of bed, 8 feet; height from floor to centers, 40 inches; swing over ways, 17½ inches; swing over slide, 10 inches; maximum distance between centers, 40 inches; diameters of cone pulley steps, 10 and 12 inches; ratio of back-gears, 6½ to 1; travel of tail-spindle, 6 inches; available rates of feed, 0.020, 0.040 and 0.060 inch per revolution; and net weight of machine, 4500 pounds.

The principal dimensions of the 20-inch machines are as follows: length of bed, 8 feet; height from floor to centers, 40 inches; swing over ways, 21 inches; swing over slide, 10 inches; maximum distance between centers, 40 inches; diameters of cone pulley steps, 10 and 12 inches; ratio of back-gears, 6½ to 1; travel of tail-spindle, 6 inches; available rates of feed, 0.080 and 0.100 inch per revolution; and net weight of machine, 4750 pounds. The standard equipment furnished with both lathes includes two No. 5 Morse taper centers, a two-speed heavy countershaft, a toolpost and the necessary wrenches.

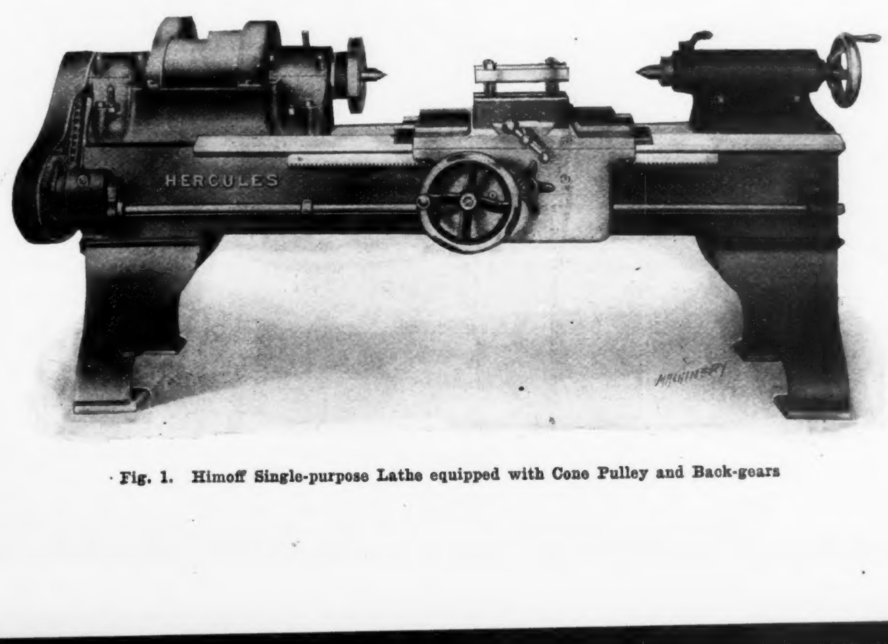
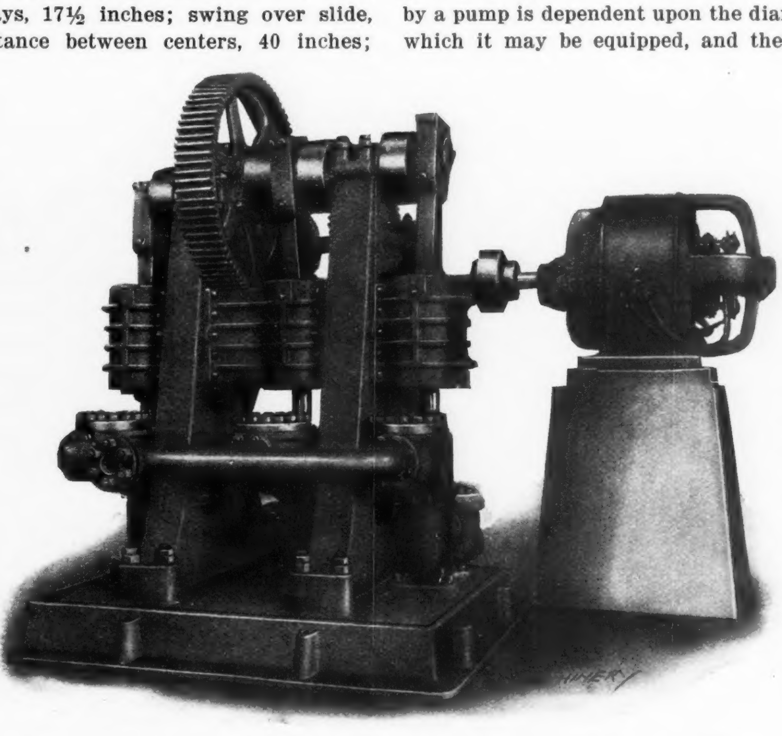


Fig. 1. Himoff Single-purpose Lathe equipped with Cone Pulley and Back-gears

HYDRAULIC TRIPLEX PUMP

For use in connection with hydraulic presses which require a large volume of water to be delivered to them at high pressure, the Hydraulic Press Mfg. Co., 84 Lincoln Ave., Mount Gilead, Ohio, has developed a vertical triplex pump of the pot valve type. The volume of water and pressure developed by a pump is dependent upon the diameter of the plungers with which it may be equipped, and the pot valves on this pump allow the plungers to be from 4 to 5¾ inches in diameter. With each plunger running at 45 strokes per minute, the 4-inch plungers have a capacity for delivering 88 gallons of water against a pressure of 1700 pounds per square inch. Under the same conditions, the 5¾-inch plungers will deliver 183 gallons against a pressure of 800 pounds per square inch. The capacity of the pump varies proportionately for the intervening sizes of plungers.



Hydraulic Triplex Pump equipped with Pot Valves on Suction and Delivery Chambers

The pump plungers of all sizes have a stroke of 12 inches and a normal running speed of 45 strokes per minute, so that the pump has a normal capacity for delivering 135 feet of water per minute against high pressure. The volume of water will, of course, vary according to the diameter of the pump plungers. On account of the large volume of water which this pump is capable of handling in a given time, each plunger is equipped with pot valves for both the suction and delivery chambers. The total area of these valves is no greater proportionally than the single-valve type; but they permit of using lighter checks which have greater freedom of movement than would be possible with a large single check. The lift of the checks is also reduced, thereby cutting down the slippage which occurs in single-suction and discharge valves when used on pumps of large water capacity. This hydraulic pump is designed for direct-connected motor drive, and a 100-horsepower motor is required. It has double-reduction gears which have ratios of 5 to 1, and 3 to 1.

The principal dimensions are as follows: height, 10 feet; and floor space occupied by pump without motor, 8 feet by 5 feet, 9 inches.

WEST HAVEN SCRIBERS, CENTER PUNCHES AND DRIVE-PIN PUNCHES

The West Haven Mfg. Co., New Haven, Conn., is now manufacturing scribers, center punches and drive-pin punches of the form shown in the accompanying illustrations. These are

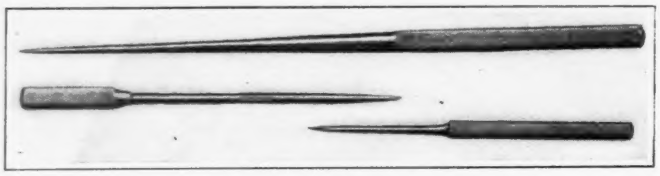


Fig. 1. Set of West Haven Scribers

known as the "O. K." brand, and each type of tool is made in three different sizes. The drive-pin punches, which are used for removing driving pins and rivets, have approximate diameters of 1/16, 5/64 and 3/32 inch. The center punches are 2¼, 2¾ and 4 inches long; and the scribers are 3½, 4¼ and 7 inches in length. The general features of all these tools are those with which experienced mechanics have become familiar.

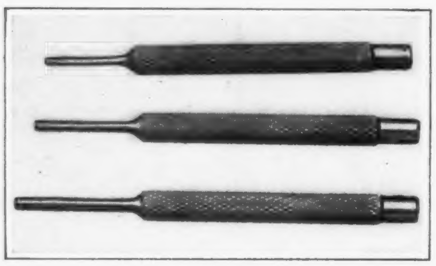


Fig. 2. Set of West Haven Drive-pin Punches

WATSON OPEN-TYPE BOX-TOOL

The open-type box-tool for screw machines, which is illustrated and described herewith, has a cast-steel body; the bars which support the cutters are made of machine steel, and the

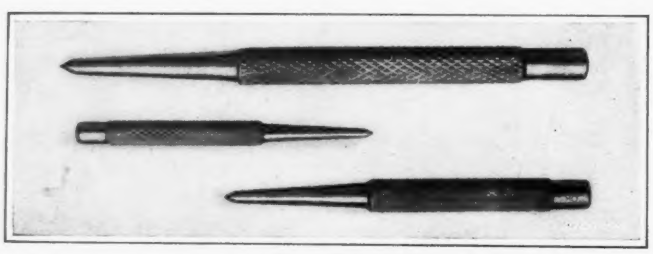
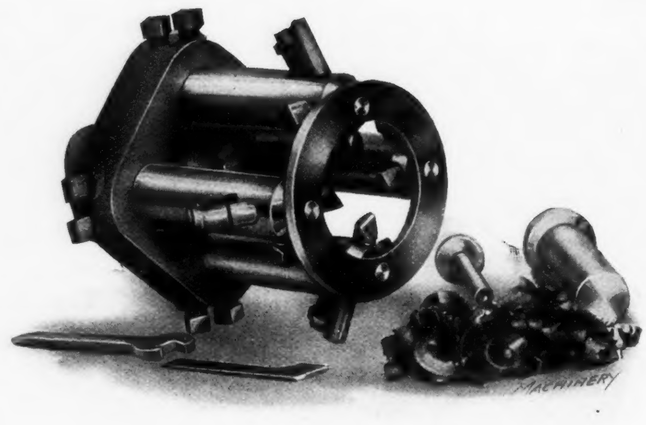


Fig. 3. Set of West Haven Center Punches

cutters are of high-speed steel. Adjustment of the cutters to provide for handling work of various diameters is effected by manipulating the small collar and set-screw located behind each cutter, which provides for adjusting the position of the cutters relative to the axis of the box-tool. The rake of each tool can be changed by releasing one of the cap-screws in the shank of the cutter holder and tightening the other screw. The open type of construction provides for free lubrication and chip clearance; and this tool also has the advantage of providing four cutting tools. It is unnecessary to use a roller block rest,

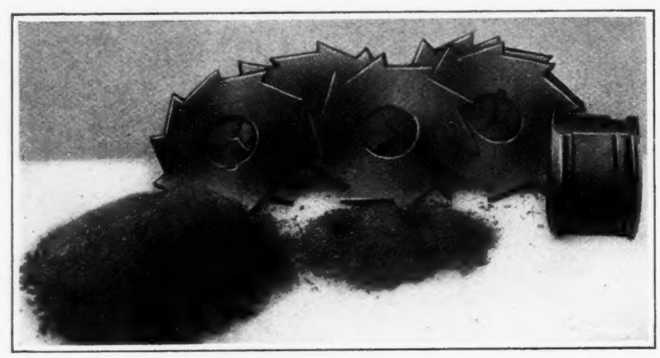


Watson Open-type Box-tool for Screw Machines

as the four tools cutting have the same effect as a rest. The Watson Mfg. Co., Toledo, Ohio, manufactures these box-tools, and they are sold by the P. H. Biggs Machinery Co., 809 Hippodrome Bldg., Cleveland, Ohio.

STEEL HEAT-TREATING COMPOUND

The Bennett Metal Treating Co., Elmwood, Hartford, Conn., has recently placed on the market a compound known as "Hetzy" which is used for heat-treating high-speed steel. With

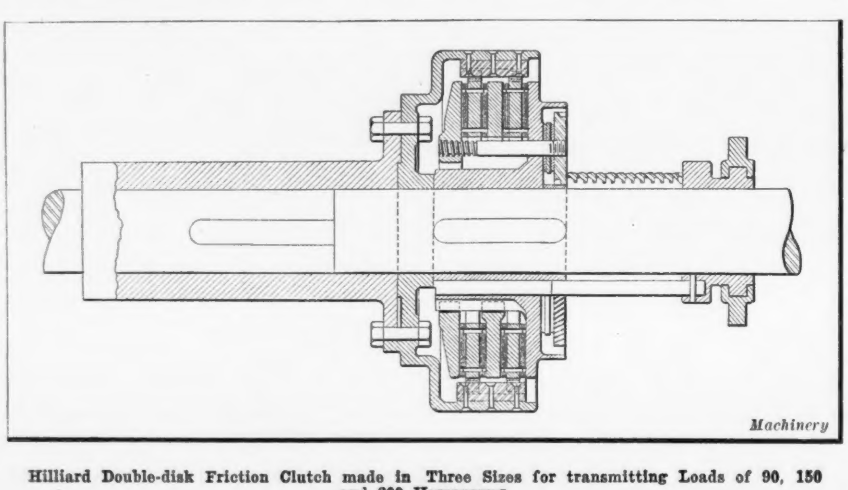


"Hetzy" and High-speed Steel Tools treated with it

the use of this compound it is claimed that steels which should ordinarily be heated to 2250 degrees F. may be satisfactorily hardened at a temperature of 1700 degrees F. This reduction of temperature means that much of the trouble experienced in heat-treating high-speed steel is avoided, and that it is possible to harden cutters without spoiling the sharp edge because the metal is not raised so near the melting temperature. "Hetzy" is a black granular powder in which the tools are packed; the heat is applied to the mass until the required hardening temperature is reached, when the tools are removed and quenched.

HILLIARD DOUBLE-DISK CLUTCH

In the February and November, 1915, numbers of MACHINERY, descriptions were published of two types of single-disk friction clutches manufactured by the Hilliard Clutch & Machinery Co., Elmira, N. Y. Recently this company has added double-disk friction clutches to its line for use in connection with drives where the amount of power is too great to be carried by a single disk. These double-disk clutches are made in three sizes known as Nos. 21, 22 and 23, and have capacities for trans-



Hilliard Double-disk Friction Clutch made in Three Sizes for transmitting Loads of 90, 150 and 200 Horsepower

mitting up to 90, 150 and 200 horsepower, respectively, when running at 100 revolutions per minute.

The operating mechanism is similar to that of the single-disk clutches previously described in MACHINERY, the movement of the friction disks being actuated by spiral racks and pinions. The multiplication of pressure provided ranges from 132 to 1 to 168 to 1 in the different sizes of clutches. The friction material used is a wire asbestos woven brake lining 1/4 inch thick which is riveted to 3/4-inch cast-iron plates, driving to alternate plain plates. They drive through hardened tool steel keys 1 inch square which are inserted and riveted to the housing.

Particular attention is called to the compact construction of the clutch. In the case of the 90-horsepower clutches, the maximum diameter is only 18 1/4 inches, and the maximum diameter of the 200-horsepower clutches is but 24 3/4 inches. This small diameter enables these clutches to be used for higher speeds than would usually be permissible where such a large amount of power is being carried.

CONVEYOR FOR REMOVING PRESS WORK

The application of mechanical methods of handling raw materials and product in industrial plants offers one of the greatest possibilities of increasing efficiency and reducing manufacturing costs. The accompanying illustrations show a conveyor

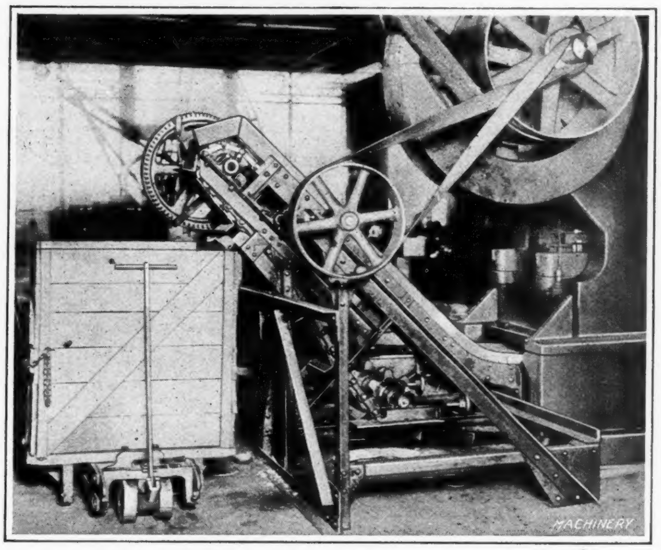


Fig. 1. Chain Belt Conveyor for transferring Product of Power Press to a Truck

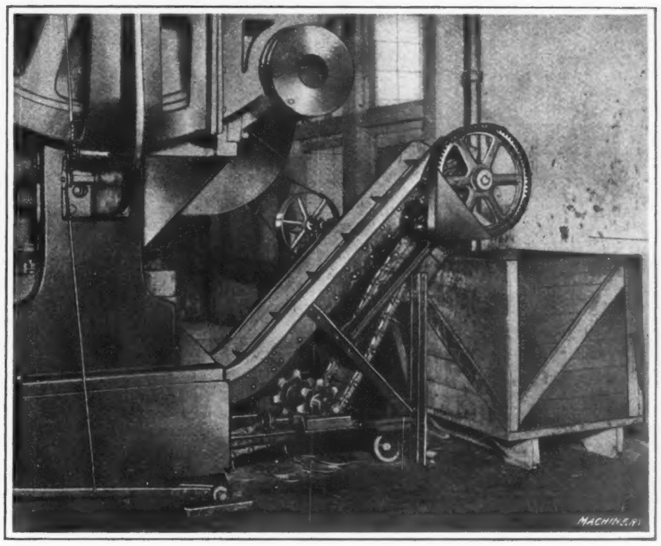


Fig. 2. Opposite Side of Conveyor, showing Angle Irons on Apron

built by the Chain Belt Co., Milwaukee, Wis., for transferring the product of a power press to a truck located at the back of the machine. It will be seen that the conveyor takes the finished pieces from the press and drops them into a box which is so constructed that when full it may be taken away by an elevating truck.

The conveyor is of simple construction, consisting of a series of flat plates which form a continuous apron; these are mounted on two strands of "griplock" roller chain belt. At intervals of about 16 inches, angle irons are attached to the flat plates so that the outstanding legs prevent the work from slipping back while it is being carried up the incline by the conveyor. The conveyor and driving mechanism are mounted on a structural steel frame so that the entire outfit forms a unit which may be easily moved to any part of the factory where it is required. The capacity is for handling over 1500 pieces of work per hour.

EMMERT DRAFTING BOARDS

The Emmert Mfg. Co., Waynesboro, Pa., is now making a line of drafting boards which are particularly adapted for using the vertical or horizontal T-square and combined protractor manufactured by this company. The board is simply constructed of kiln-dried white pine, and is mounted on a substantial iron stand. The inclination can be adjusted to meet the requirements of the draftsman, and a counterweight balances the weight of the board, making it an easy matter to regulate its position vertically; in addition, the board can be moved toward or away from the draftsman. The universal adjustment provided in this way insures a degree of comfort

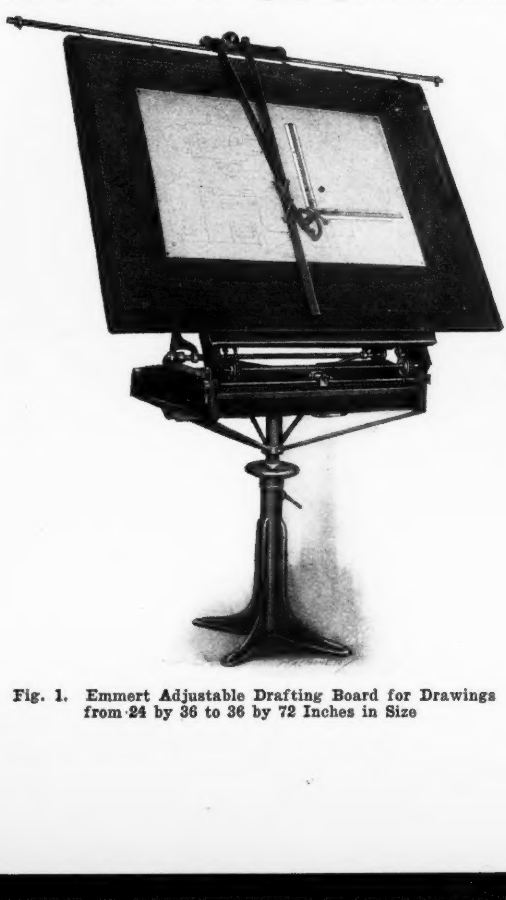


Fig. 1. Emmert Adjustable Drafting Board for Drawings from 24 by 36 to 36 by 72 Inches in Size

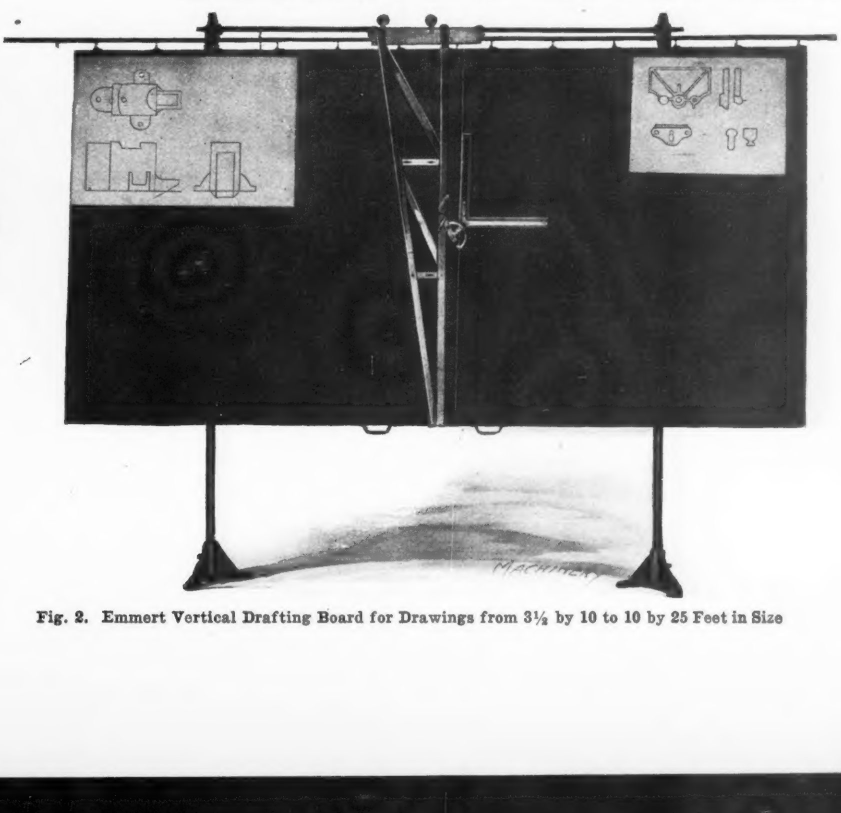


Fig. 2. Emmert Vertical Drafting Board for Drawings from 3 1/2 by 10 to 10 by 25 Feet in Size

which should manifest itself in the quality and quantity of work produced by the draftsman. These boards are made in sizes for handling drawings from 24 by 36 to 36 by 72 inches in size.

In addition to the type of board mounted on an iron stand (shown in Fig. 1), a similar board is made without a stand so that it may be placed directly upon a table in the drafting-room. Fig. 2 shows a vertical board for use in making large assembly drawings, full-sized drawings, etc. This is made in sizes to accommodate drawings from 3½ by 10 feet up to 10 by 25 feet. The board is supported on upright posts and may be placed near the wall where it is out of the way except when wanted for use in making large-sized drawings.

BRINELL METER FOR HARDNESS TESTS

The results of the Brinell test have been generally accepted as a standard of hardness, but the application of this method has been limited for three reasons: (1) It has been impossible to apply the test at any desired point on a large piece of metal or for testing metal products of irregular shape; (2) thin sheets of metal or hollow metal bodies could not be tested because the high pressure applied to the ball resulted in the destruction of such pieces; (3) the apparatus for conducting the test could not conveniently be carried around by metallurgists or testing engineers, so that it was necessary to bring all test samples to the laboratory.

With the view of overcoming these difficulties, the Standard Roller Bearing Co. developed an instrument known as the Brinell meter which weighs only 7 pounds so that it can be easily carried about the factory; and the instrument operates in such a way that the limitations referred to are entirely overcome. The Brinell meter consists of a housing, in the lower end of which is loosely supported a hardened steel ball 10 millimeters in diameter. There is a transverse slot in the housing in which is inserted a steel test bar of known hardness, and the housing carries a hardened steel plunger, the lower end of which contacts with this bar.

It will be evident from the illustrations that the relative positions of these members are such that the 10-millimeter ball contacts with the test bar on one side and with the metal to be tested on the other side. The height of the transverse slot in the housing is such that the test bar has the necessary amount of vertical play, and the plunger carried by the housing is pushed down by a compression spring so that the test bar is held in contact with the 10-millimeter ball. In making the test, the ball is applied to the work, after which the housing is pushed down so that the bottom of the test bar is clear of the bottom of the slot in the housing. The top of the hardened steel plunger is then struck a sharp blow with a three-pound hammer, which results in producing an indentation in both the test bar and the metal to be tested.

From the familiar principle of mechanics that action and reaction are equal, opposite and simultaneous, it will be evident that the force of the hammer blow is applied equally to the work and to the test bar, with the result that the indentations produced by the 10-millimeter ball are proportional to the hardness of the metal. We have the familiar formula for the Brinell hardness test:

$$\frac{X}{S} = \frac{D^2}{D_1^2}$$

where X = unknown hardness of material;
S = known hardness of test bar;
D = diameter of impression made in test bar;
D_1 = diameter of impression made in work.

Scales are provided with the instrument which enable the diameters of the impressions to be measured with an accuracy of 1/20 millimeter, and knowing the hardness S of the test bar, it is an easy matter to solve this equation for the unknown hardness of the work.

Fig. 2. Complete Brinell Meter Outfit packed in its Case

VALUES OF RATIO $D : D_1$ AND CORRESPONDING HARDNESS FOR TEST BAR HAVING HARDNESS VALUE OF 170

Ratio	Brinell Hardness	Ratio	Brinell Hardness	Ratio	Brinell Hardness	Ratio	Brinell Hardness
0.90	137	1.07	194	0.99	167	1.16	229
0.91	140	1.08	198	1.00	170	1.17	233
0.92	144	1.09	202	1.01	174	1.18	237
0.93	147	1.10	206	1.02	177	1.19	241
0.94	150	1.11	210	1.03	181	1.20	245
0.95	153	1.12	213	1.04	184	1.21	249
0.96	156	1.13	217	1.05	187	1.22	253
0.97	160	1.14	221	1.06	190	1.23	257
0.98	163	1.15	225	....	....	....	...

Machinery

To facilitate making the test, tables have been compiled for different values of the known hardness S of the test bar. To use these tables, it is merely necessary to measure the diameters of the impressions and then obtain the value of the ratio $\frac{D}{D_1}$. Then referring to the table, the corresponding value of the hardness is found opposite the proper value of the ratio. The table which accompanies this article is calculated for a hardness value of 170, which is the hardness of one of the standard test bars. Test bars with a hardness of 170 are suitable for use in testing metals with hardness values ranging from 130 to 225; for testing materials with hardness values ranging from 200 to 300, the hardness of the test bar should be 250.

Fig. 1. The Brinell Meter for rapidly making Hardness Tests

To explain the method of obtaining hardness numbers both by calculation and the use of the table, the following problem will be carried through. Suppose the diameter D of the impression in the test bar is 4.2 millimeters, and the diameter D_1 of the impression made in the work is 4.0 millimeters. The known value S of the hardness of the test bar is 170. Substituting these values in the Brinell equation, we have:

$$X = 170 \frac{4.2^2}{4^2} = 187.$$

The value of the ratio will be:

$$\frac{D}{D_1} = \frac{4.2}{4} = 1.05.$$

Referring to the table for a ratio value of 1.05, we find the value of the hardness is 187 which checks the calculated result.

It will be evident that tests can be conducted very rapidly with this instrument, and as it is packed in a leather case 9¼ by 6¼ by 2¾ inches in size and weighs only seven pounds, it is very convenient to carry about the factory. As a result, the instrument is suitable for the use of inspectors who have occasion to make trips through industrial plants. Another application is in the testing of shipments of raw materials which are bought on specifications that include a hardness clause. The regular equipment furnished with the Brinell meter includes three test bars having a hardness of 170, three test bars having a hardness of 250, twelve 10-millimeter hardened steel balls, two scales for measuring the diameters of impressions, one set of direct-reading tables, a set of instructions, and a wrench for opening the instrument. Special test bars may be furnished of any desired hardness. After the test bars have been used up on all sides, they can be ground to remove the impressions and make them suitable for further service. The Brinell meter, patented by the Standard Roller Bearing Co., is manufactured, under a sole license agreement, by Herman A. Holz, 50 Church St., New York City.

NEWTON LOCOMOTIVE FRAME DRILLING MACHINE

The Newton Machine Tool Works, Inc., 23rd and Vine Sts., Philadelphia, Pa., is now building a drilling machine which has sufficient range and flexibility to provide for the performance of drilling operations on all parts of locomotive engines of various sizes; and this machine is particularly adapted for drilling locomotive frames. The spindles have an automatic geared feed of 18 inches, and a vertical adjustment of 18 inches through direct-connected gearing for the fast hand traverse, and through worm and wheel for slow hand adjustment. Four changes of feed are provided, which are 0.0078, 0.0126, 0.0156 and 0.0185 inch per revolution. The range of spindle speeds is from 28 to 456 revolutions per minute.

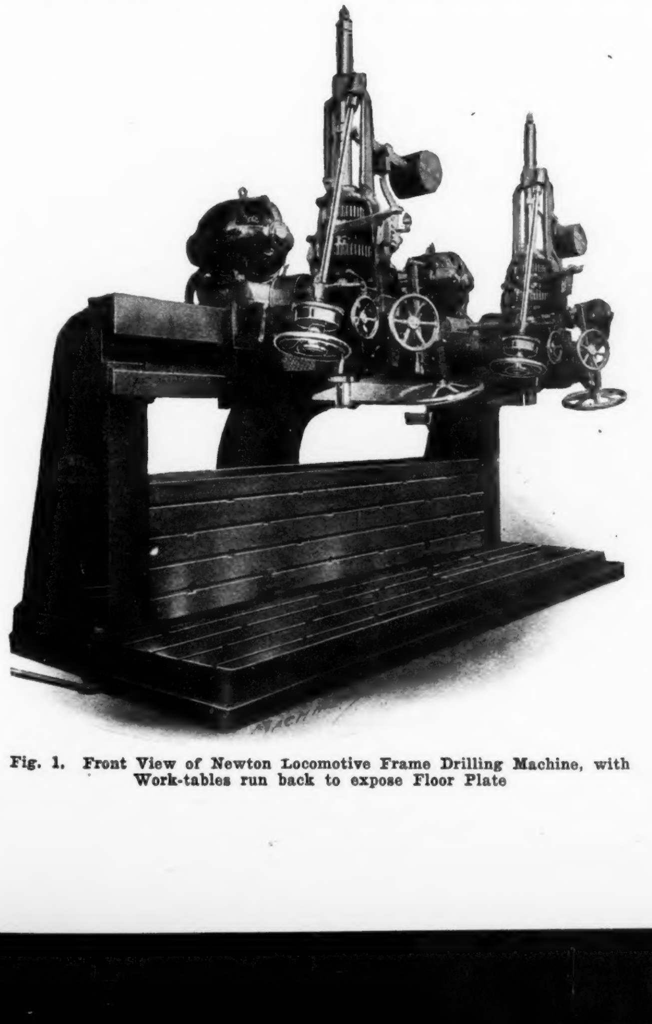


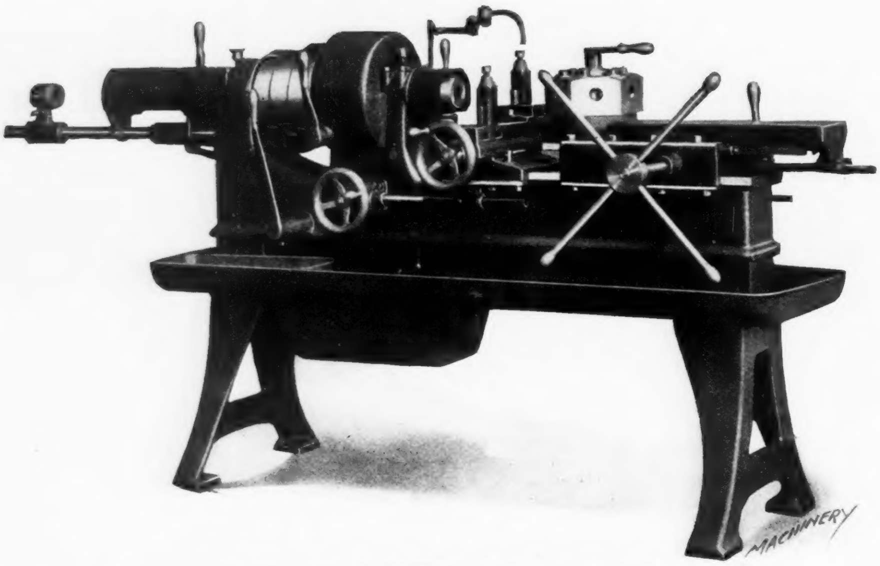
Fig. 1. Front View of Newton Locomotive Frame Drilling Machine, with Work-tables run back to expose Floor Plate

Fig. 2. Partial Rear View of Machine shown in Fig. 1, with Work-tables moved out under Drill Spindles

The spindles are driven by ten-horsepower electro-dynamic motors which run at from 300 to 1200 revolutions per minute. Motion is transmitted through horizontal driving shafts, on each of which is mounted a double train of bevel gears, and thence through vertical shafts and spur gears which give two changes of speed in addition to the variation provided by the motors. The spindles are counterweighted to facilitate the return movement. They are bored No. 5 Morse taper and provided with retaining and drift key holes. Reversing fast traverse is provided, for moving the saddles on the rail from the minimum distance between spindles of 48 inches to the maximum distance of 15 feet. Hand horizontal adjustment of the spindles is obtained by a handwheel at the bottom of the arm.

The gear-box which controls the feed is mounted on the column, the different gear combinations being engaged by a spring key controlled by a small hand-lever. Lateral hand adjustment is provided for the position of the spindle saddle on the arm from a minimum distance of 6 inches to a maximum distance of 24 inches from the face of the cross-rail. The arm has two bearings at the top of the cross-rail which are removable to facilitate renewal, and square lock gibbed bearings are cast integral with the brass taper shoes to afford means of compensating for wear. The motor brackets are cast integral with the arm to provide the required rigidity for heavy work.

The cross-rail is of the box type construction and ribbed to give additional rigidity. The machine is furnished with two adjustable work-tables, each of which is of the box type and has vertical and horizontal working surfaces with T-slots for clamping the work. It will also be noticed that the base of the machine is extended to form a floor plate in which T-slots are cut for securing large pieces of work ready for drilling. When using the floor plate, the tables are pushed back to the position shown in Fig. 1, this movement of the tables being obtained by motor-driven screws. The movement of the two tables is independently controlled; and in addition to moving the tables back to expose the floor plate, this adjustment is employed for bringing the work clamped to the tables into the desired position under the drill spindles. The principal dimensions are as follows: floor space occupied, 19



Kent-Owens No. 4 Friction-head Hand Screw Machine

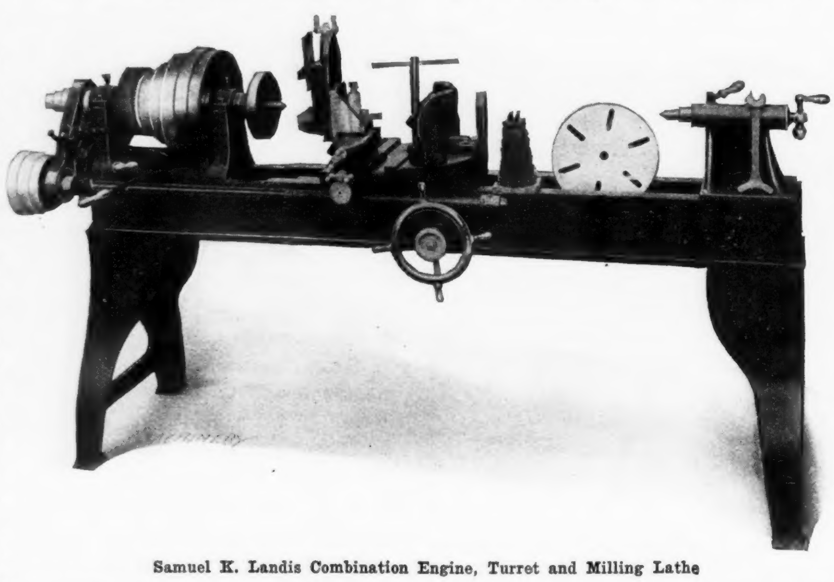
by 20 feet; maximum distance from floor plate to bottom of spindles, 81 inches; maximum distance from end of spindle to top of adjustable work-table, 48 inches; minimum distance from top of floor plate to bottom of spindles, 64 inches; and minimum distance from end of spindle to top of adjustable table, 43 inches.

KENT-OWENS SCREW MACHINE

The No. 4 friction-head hand screw machine shown in the accompanying illustration is manufactured by the Kent-Owens Machine Co., Toledo, Ohio; and the P. H. Biggs Machinery Co., 809 Hippodrome Bldg., Cleveland, Ohio, has the sales agency. The spindle bearings are bronze-bushed and provided with oil reservoirs; and it will be seen that the head and bed are cast in a single piece with guards to provide adequate protection for all the gearing. Independent automatic stops are furnished for each position of the turret. The cut-off slide has hand lateral adjustment along the bed, and the cross-slide adjustment is actuated by the usual arrangement of screw and handwheel. Machines of this type are built either with or without power feed to the turret. Tapered gibs are used in making adjustment for any wear which may develop in the turret slide. The spindle has a capacity for handling stock up to 1 5/8 inch in diameter; and provision is made for lubricating the work and tools by a pump which draws cutting compound from a reservoir located beneath the oil pan.

SAMUEL K. LANDIS LATHE

The accompanying illustration shows what is known as a combination engine, turret and milling lathe which is built by Samuel K. Landis, 53 North Duke St., Lancaster, Pa. The machine is said to be adapted for such operations as cylinder boring, drilling, milling, and slotting, in addition to the usual classes of lathe work. It will be seen that in place of the usual lathe carriage, there is a special carriage which carries a turret. This turret is square at one side and round at the other; the square end is provided with a raised guide which supports a compound rest, while various tools may be secured to the opposite side of the turret. The head is so constructed that the clutch, reverse and back-gears are conveniently controlled by means of the two hand-levers shown. The spindle bearings are lined with phosphor-bronze, and the gears are carefully enclosed to provide for the safety of the operator. The bed is sufficiently braced to give the required rigidity.

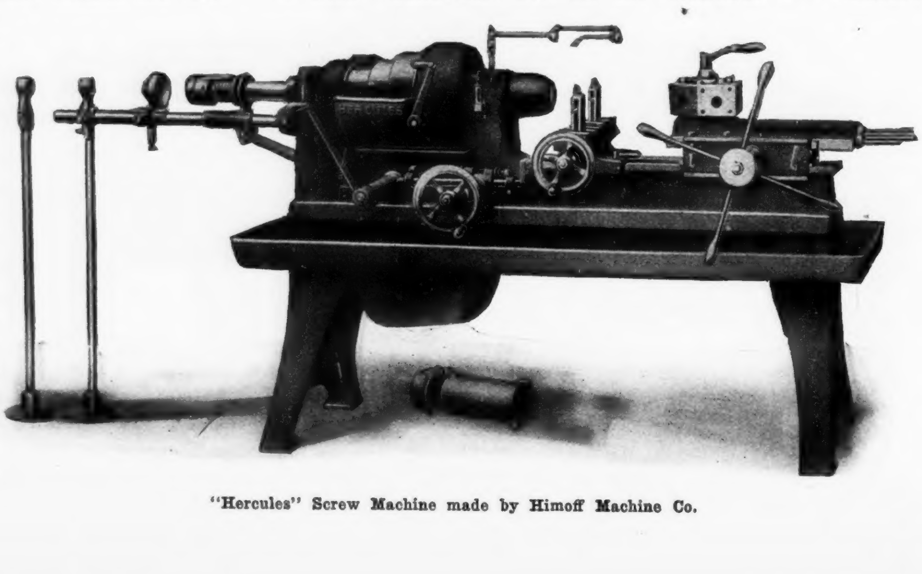


Samuel K. Landis Combination Engine, Turret and Milling Lathe

The principal dimensions and specifications for this machine are as follows: swing over ways, 17 inches; swing over carriage, 10 inches; length of bed, 7 feet; distance between centers, 52 inches; diameter of hole through spindle, 1 9/16 inch; ratio of back-gears, 3½ to 1; capacity for thread cutting, eight to thirty threads per inch; and weight of machine, 1400 pounds.

HIMOFF SCREW MACHINE

The Himoff Machine Co., Inc., 128 Mott St., New York City, is now building a hand screw machine which is made in No. 2 and No. 4 sizes. It will be seen that the head is cast integral with the bed, and the bed is provided with ribs to stiffen the construction. In this connection attention is called to the pulley guard which is cast integral with the head so that it also assists in reducing the possibility of strain or vibration. The spindle is machined from a 50-point carbon steel forging which is bored and threaded to receive a collet nose, and then hardened and ground. The turret is revolved automatically by the backward movement of the turret slide. Handwheel feed for the cross-slide is a standard



"Hercules" Screw Machine made by Himoff Machine Co.

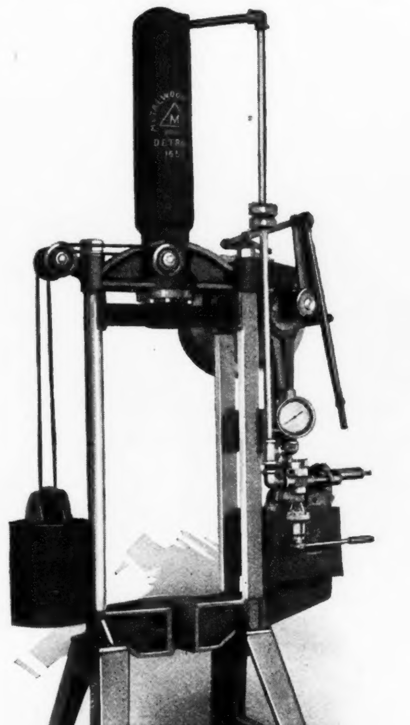
feature of this machine, and positive stops are furnished for the longitudinal feed to the cut-off slide. The No. 4 machine may be furnished with power feed for both the cross-slide and turret. Special features of these screw machines are positive length stops for the cross-slide, and the provision of a chain oiling system for the spindle bearings.

The principal dimensions of the No. 2 machine are as follows: capacity of chuck, up to 1 inch in diameter; diameter of hole in spindle, $1\frac{1}{4}$ inch; swing over bed, 14 inches; swing over cut-off slide, 6 inches; maximum length of work that can be turned, 6 inches; maximum distance from end of spindle to turret, 14 inches; width of driving belt, $2\frac{3}{4}$ inches; available spindle speeds, 460, 288 and 184 R. P. M.; floor space occupied, 2 feet, 3 inches by 6 feet; and weight of machine, 1310 pounds.

The principal dimensions of the No. 4 machine are as follows: capacity of chuck, $1\frac{1}{2}$ inch; diameter of hole in spindle, 1 27/32 inch; diameter of turret holes, $1\frac{1}{2}$ inch; swing over bed, 16 inches; swing over cut-off slide, $6\frac{1}{4}$ inches; maximum length of work that can be turned, 8 inches; maximum distance from end of spindle to turret, 18 inches; width of driving belt, $3\frac{1}{2}$ inches; available spindle speeds, 165, 108 and 70 R. P. M.; floor space occupied, 2 feet, 3 inches by 6 feet; and net weight of machine, 1650 pounds.

METALWOOD BROACHING PRESS

To meet the requirements of heavy broaching operations, the Metalwood Mfg. Co., Leib and Wight Sts., Detroit, Mich.,



Metalwood Vertical Hydraulic Broaching Press

has recently added to its line of hydraulic presses the 35-ton vertical broaching press illustrated and described herewith. The press is provided with a five-horsepower Metalwood duplex pump which runs at 200 revolutions per minute. To facilitate handling the broach, the hole in the platen is made U-shaped. The features of the machine are its capacity for handling heavy work, speed of operation and economy of floor space.

In tests conducted with the press while the pump was running at 170 revolutions per minute, the following results were obtained: average time for down stroke, 38 seconds; average time for return stroke, 8 seconds; and pressure developed, 45 tons. The principal dimensions of the machine are as follows: diameter of ram, $4\frac{1}{2}$ inches; stroke of ram, 30 inches; diameter of round column, $2\frac{3}{4}$ inches; size of rectangular columns, 2 by 3 inches; maximum distance from face of ram to platen, 44 inches; space between columns, $23\frac{1}{4}$ inches; distance from floor to face of platen, 31 inches; diameter of hole in platen, 4 inches; total height of machine, 10 feet, 6 inches; floor space occupied, 32 by 39 inches; and weight of machine, 3200 pounds.

REED-PRENTICE SHELL LATHE

To meet the requirements of turning shrapnel and high-explosive shells the Reed-Prentice Co., Worcester, Mass., has developed a machine which employs many of the principles of construction used on the automatic turning and facing machine of this company's manufacture. The lathe is driven by a ten-horsepower Westinghouse motor mounted on the head, from which power is transmitted to the spindle through direct-connected gearing. Any type of motor may be furnished according to the requirements of the shop, and a handwheel is provided on the motor by means of which the drive is controlled. In order to eliminate chatter and vibration, a pair of herringbone gears is employed in the head.

It will be noticed that the handle which binds the tailstock spindle in any required position is placed beneath the spindle rather than above it. This method has the advantage of leaving an unbroken surface to support the upward thrust which occurs when the cutting tools are in operation. No changes of feed have been provided, as the builders of this lathe determined the most satisfactory rate of feed for the work for which the machine is intended and constructed it accordingly.

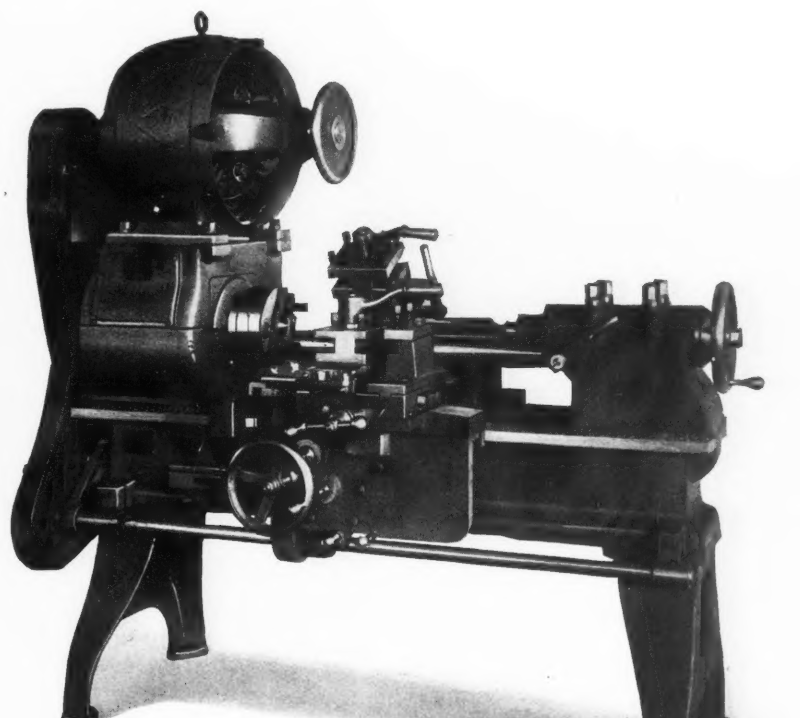
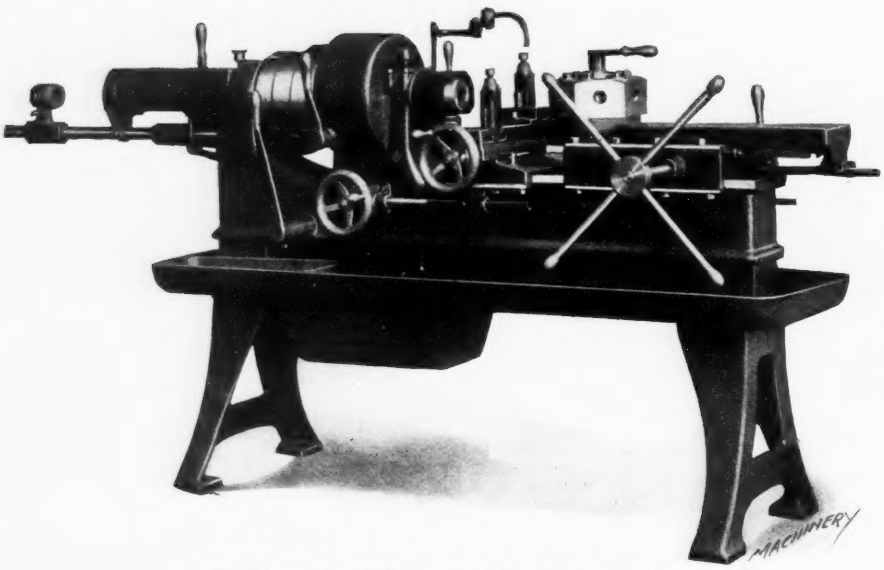


Fig. 1. Reed-Prentice Automatic Shell Turning and Facing Lathe

This does away with the possibility of an unskilled operator using any other than the most suitable rate of feed. The apron carries a drop-worm mechanism which is disengaged at a predetermined point to stop the feed automatically.

It will be seen that there are turret tool-blocks at both the front and back of the machine to provide for the use of roughing and finishing tools. The front turret tool-block is placed beside a stationary tool-block. The first tool in the turret and the tool in the stationary block perform the rough-turning operation, after which the turret is indexed to bring the finish-turning tool into the working position. It will be evident that while the finishing tool is at work the roughing tool in the fixed block moves past the work without actually touching it. The tools are actuated by a former which governs the



Kent-Owens No. 4 Friction-head Hand Screw Machine

by 20 feet; maximum distance from floor plate to bottom of spindles, 81 inches; maximum distance from end of spindle to top of adjustable work-table, 48 inches; minimum distance from top of floor plate to bottom of spindles, 64 inches; and minimum distance from end of spindle to top of adjustable table, 43 inches.

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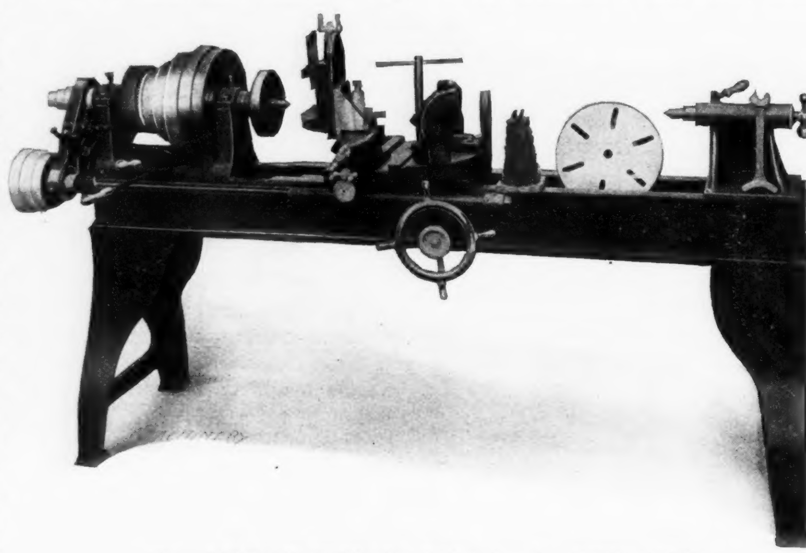

Samuel K. Landis Combination Engine, Turret and Milling Lathe

The principal dimensions and specifications for this machine are as follows: swing over ways, 17 inches; swing over carriage, 10 inches; length of bed, 7 feet; distance between centers, 52 inches; diameter of hole through spindle, 1 9/16 inch; ratio of back-gears, 3½ to 1; capacity for thread cutting, eight to thirty threads per inch; and weight of machine, 1400 pounds.

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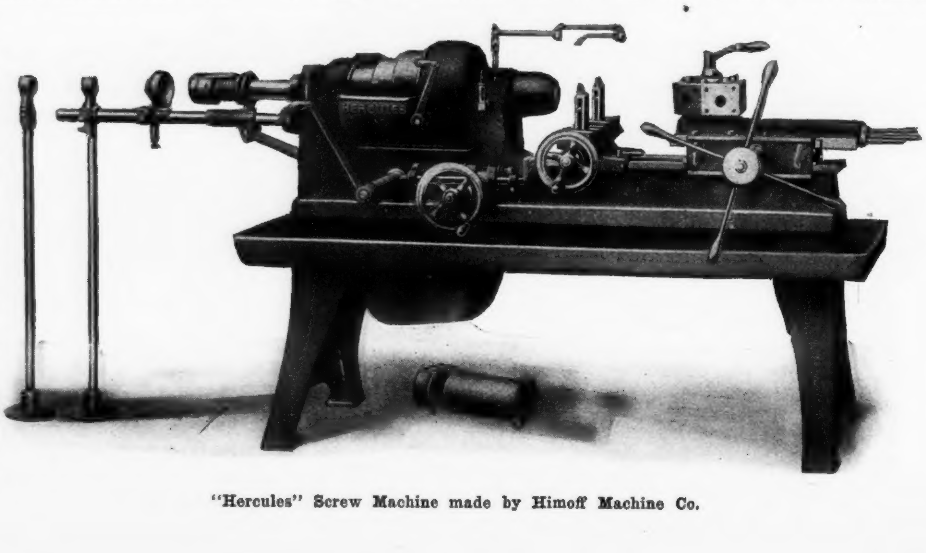
The No. 4 friction-head hand screw machine shown in the accompanying illustration is manufactured by the Kent-Owens Machine Co., Toledo, Ohio; and the P. H. Biggs Machinery Co., 809 Hippodrome Bldg., Cleveland, Ohio, has the sales agency. The spindle bearings are bronze-bushed and provided with oil reservoirs; and it will be seen that the head and bed are cast in a single piece with guards to provide adequate protection for all the gearing. Independent automatic stops are furnished for each position of the turret. The cut-off slide has hand lateral adjustment along the bed, and the cross-slide adjustment is actuated by the usual arrangement of screw and handwheel. Machines of this type are built either with or without power feed to the turret. Tapered gibs are used in making adjustment for any wear which may develop in the turret slide. The spindle has a capacity for handling stock up to 1 5/8 inch in diameter; and provision is made for lubricating the work and tools by a pump which draws cutting compound from a reservoir located beneath the oil pan.

HIMOFF SCREW MACHINE

The Himoff Machine Co., Inc., 128 Mott St., New York City, is now building a hand screw machine which is made in No. 2 and No. 4 sizes. It will be seen that the head is cast integral with the bed, and the bed is provided with ribs to stiffen the construction. In this connection attention is called to the pulley guard which is cast integral with the head so that it also assists in reducing the possibility of strain or vibration. The spindle is machined from a 50-point carbon steel forging which is bored and threaded to receive a collet nose, and then hardened and ground. The turret is revolved automatically by the backward movement of the turret slide. Handwheel feed for the cross-slide is a standard



"Hercules" Screw Machine made by Himoff Machine Co.

feature of this machine, and positive stops are furnished for the longitudinal feed to the cut-off slide. The No. 4 machine may be furnished with power feed for both the cross-slide and turret. Special features of these screw machines are positive length stops for the cross-slide, and the provision of a chain oiling system for the spindle bearings.

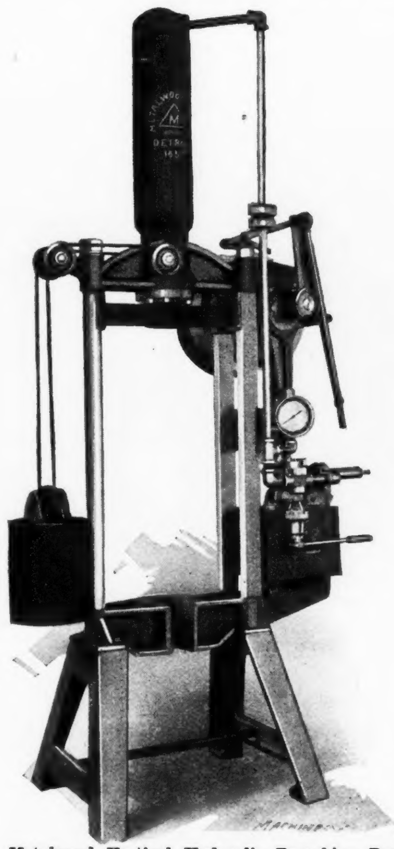
The principal dimensions of the No. 2 machine are as follows: capacity of chuck, up to 1 inch in diameter; diameter of hole in spindle, 1¼ inch; swing over bed, 14 inches; swing over cut-off slide, 6 inches; maximum length of work that can be turned, 6 inches; maximum distance from end of spindle to turret, 14 inches; width of driving belt, 2¾ inches; available spindle speeds, 460, 288 and 184 R. P. M.; floor space occupied, 2 feet, 3 inches by 6 feet; and weight of machine, 1310 pounds.

The principal dimensions of the No. 4 machine are as follows: capacity of chuck, 1½ inch; diameter of hole in spindle, 1 27/32 inch; diameter of turret holes, 1½ inch; swing over bed, 16 inches; swing over cut-off slide, 6¼ inches; maximum length of work that can be turned, 8 inches; maximum distance from end of spindle to turret, 18 inches; width of driving belt, 3½ inches; available spindle speeds, 165, 108 and 70 R. P. M.; floor space occupied, 2 feet, 3 inches by 6 feet; and net weight of machine, 1650 pounds.

METALWOOD BROACHING PRESS

To meet the requirements of heavy broaching operations, the Metalwood Mfg. Co., Leib and Wight Sts., Detroit, Mich., has recently added to its line of hydraulic presses the 35-ton vertical broaching press illustrated and described herewith. The press is provided with a five-horsepower Metalwood duplex pump which runs at 200 revolutions per minute. To facilitate handling the broach, the hole in the platen is made U-shaped. The features of the machine are its capacity for handling heavy work, speed of operation and economy of floor space.

In tests conducted with the press while the pump was running at 170 revolutions per minute, the following results were obtained: average time for down stroke, 38 seconds; average time for return stroke, 8 seconds; and pressure developed, 45 tons. The principal dimensions of the machine are as follows: diameter of ram, 4½ inches; stroke of ram, 30 inches; diameter of round column, 2¾ inches; size of rectangular columns, 2 by 3 inches; maximum distance from face of ram to platen, 44 inches; space between columns, 23¼ inches; distance from floor to face of platen, 31 inches; diameter of hole in platen, 4 inches; total height of machine, 10 feet, 6 inches; floor space occupied, 32 by 39 inches; and weight of machine, 3200 pounds.



Metalwood Vertical Hydraulic Broaching Press

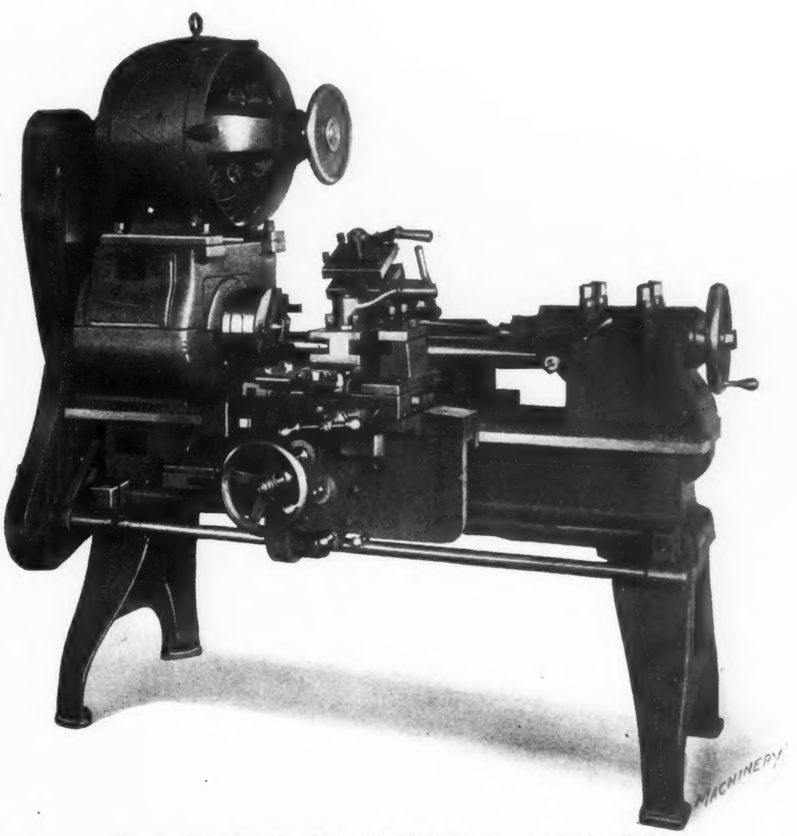


Fig. 1. Reed-Prentice Automatic Shell Turning and Facing Lathe

REED-PRENTICE SHELL LATHE

To meet the requirements of turning shrapnel and high-explosive shells the Reed-Prentice Co., Worcester, Mass., has developed a machine which employs many of the principles of construction used on the automatic turning and facing machine of this company's manufacture. The lathe is driven by a ten-horsepower Westinghouse motor mounted on the head, from which power is transmitted to the spindle through direct-connected gearing. Any type of motor may be furnished according to the requirements of the shop, and a handwheel is provided on the motor by means of which the drive is controlled. In order to eliminate chatter and vibration, a pair of herringbone gears is employed in the head.

It will be noticed that the handle which binds the tailstock spindle in any required position is placed beneath the spindle rather than above it. This method has the advantage of leaving an unbroken surface to support the upward thrust which occurs when the cutting tools are in operation. No changes of feed have been provided, as the builders of this lathe determined the most satisfactory rate of feed for the work for which the machine is intended and constructed it accordingly. This does away with the possibility of an unskilled operator using any other than the most suitable rate of feed. The apron carries a drop-worm mechanism which is disengaged at a predetermined point to stop the feed automatically.

It will be seen that there are turret tool-blocks at both the front and back of the machine to provide for the use of roughing and finishing tools. The front turret tool-block is placed beside a stationary tool-block. The first tool in the turret and the tool in the stationary block perform the rough-turning operation, after which the turret is indexed to bring the finish-turning tool into the working position. It will be evident that while the finishing tool is at work the roughing tool in the fixed block moves past the work without actually touching it. The tools are actuated by a former which governs the

contour of the work by automatically regulating the position of the cross-slide.

The rear tool-block is supported by a bar from which it swings to provide the feed motion for facing the end of the shell, turning a "radius" on the end of the shell, and turning the copper band seat. The movement of this tool-block is governed by a cam carried by the carriage; a roller attached to the tool-block runs in this cam and swings the tool-block on the supporting bar. The arrangement of the tools for facing, turning the radius at the end, and rough- and finish-turning the band seat is clearly shown

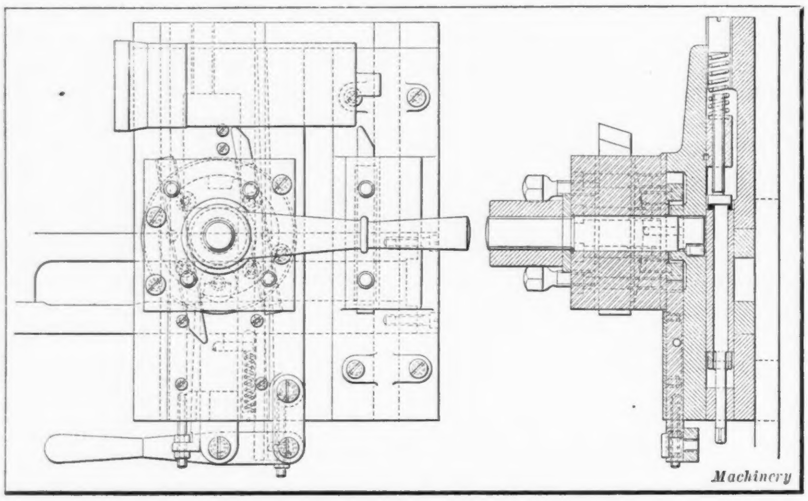


Fig. 2. Arrangement of Tools used for Turning Operations

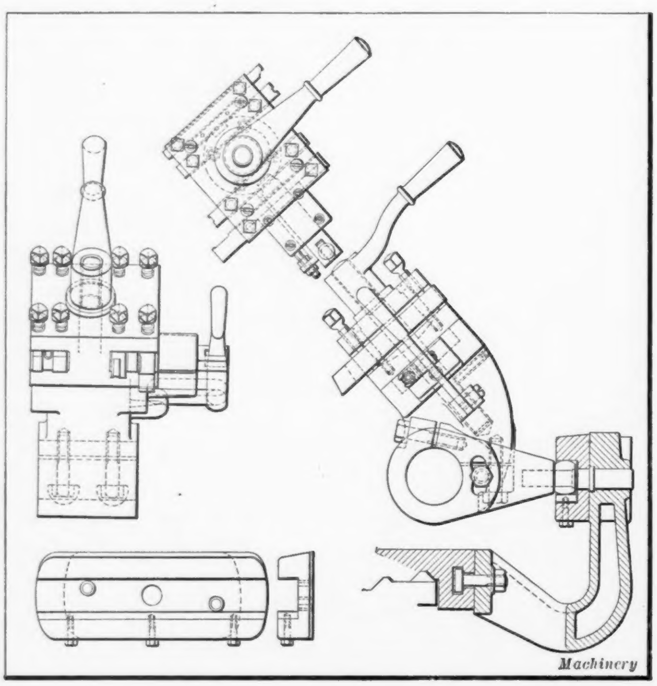


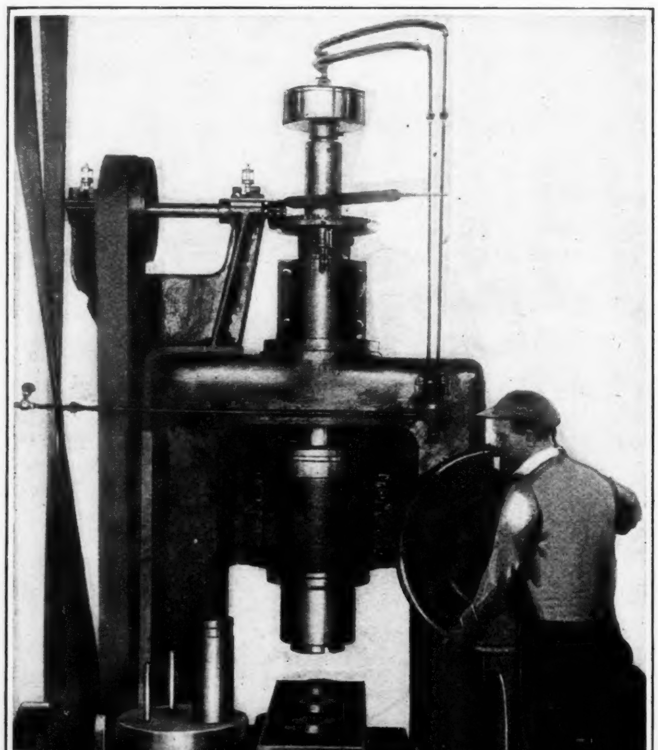
Fig. 3. Arrangement of Tools used for Facing and Band-seat Turning Operations

in Fig. 3. These operations are performed at the same time that the turning operations are handled by the tools at the front of the cross-slide. Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York City, have the sales agency for this machine.

DUNLAP PROJECTILE BORING MACHINE

The projectile boring machine illustrated and described herewith is a recent addition to the line of the Dunlap Machinery Sales Co., Dayton, Ohio, and represents a departure from ordinary practice in the design of machinery for shell boring. The machine is fitted with a pneumatic chuck and the end of the spindle is enlarged to provide for carrying jaws for holding various sizes of shells up to 6 inches in diameter. The enlarged end of the spindle provides a bearing surface 14 inches in diameter by 16 inches long; the bearing is lined with babbitt. The feed motion is obtained through a handwheel at the front of the machine or by power; and a quick hand or power traverse of the spindle is available in either direction. The heavy platen shown in the illustration is provided with holes for holding a series of tools, and is carried on a slide cast integral with the base of the machine. A platen centering device provides for centering any tool with the spindle, after which the platen is locked firmly in place so that the centering pin is not called upon to take any of the strain.

The advantages claimed for this machine are that the shell is inverted so that the chips drop out and do not interfere with the action of the cutting tools; and that the machine is sufficiently rigid to enable the tools to form the powder pocket and diaphragm seat absolutely concentric with the outside wall of the shell, irrespective of any eccentricity of the forged hole. The principal dimensions of the machine are as follows: capacity, for boring shells up to 6 inches in diameter; floor space occupied, 84 by 50 inches; width of driving belt, 6 inches; available power feeds, 0.007, 0.011, 0.016, 0.023, 0.034 and 0.053 inch per revolution of the spindle; and weight of machine, 10,000 pounds. The equipment furnished with the

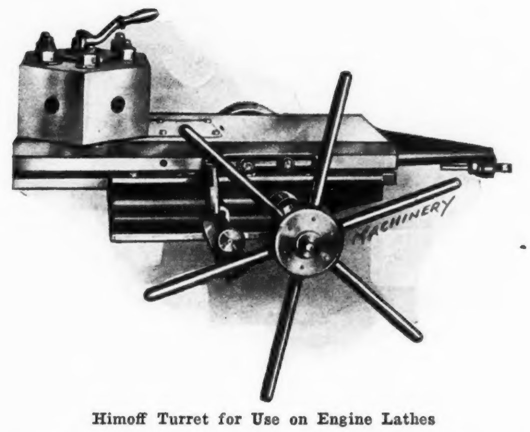


Vertical Projectile Boring Machine built by Dunlap Machinery Sales Co.

machine includes a lubricating pump and piping, an air chuck and connections, and the necessary wrenches for making adjustments.

HIMOFF TURRET

For application on any of the lathes of its manufacture, the Himoff Machine Co., Inc., 128 Mott St., New York City, manufactures the "Hercules" turret attachment shown in the accompanying illustration. This attachment is planed to fit on



Himoff Turret for Use on Engine Lathes

the ways of the lathe and can be furnished with power feed to special order. The illustration makes the arrangement of this device quite clear without further description.

POESE AUTOMATIC NUT TAPPER

The Poese Engineering & Mfg. Co., Cleveland, Ohio, has recently added to its line a two-spindle automatic nut tapping attachment for use in tapping spark plug nuts and similar pieces. This attachment is used on the tapping machine of this company's manufacture; it consists of a two-spindle head *A* which is driven by feed-screw *B* of the tapping machine, the taps being fed in or backed out of the work according to the direction of rotation of the feed-screw.

The nut blanks to be tapped are placed in hopper *C* from which they are delivered to the attachment through chutes *D*. In order that the work may come to the fixture with the proper side up, an agitator driven by a small round belt pushes the pieces through gates in the hopper which are slightly larger than the work, and they are so formed that the pieces can only pass through when in the correct position. A cam is attached to the end of the feed-screw, and as the tapping head feeds down this cam holds the two pieces of work securely in position against an adjustable stop. The adjustment of the stop provides for setting it for holding work of different sizes.

Automatic Nut Tapping Attachment for Use on Tapping Machines built by Poese Engineering & Mfg. Co.

During the return of the tapping head, the springs pull the fixture plate back and release the work; then two more blanks slide into place ready for the next cycle of operations to be performed. As each two pieces are tapped, they are pushed into a receiver which is taken to the next department when full. It is stated that on 5-40 brass nut blanks, the capacity of the machine is 2000 nuts per hour; so that the operator handling five machines can tap 100,000 nuts in a ten-hour day.

NEW MACHINERY AND TOOLS NOTES

Hydraulic Press: Metalwood Mfg. Co., Leib and Wight Sts., Detroit, Mich. A quick-acting hydro-pneumatic press capable of making ten full strokes per minute, while developing its full rated capacity. This press is intended for the performance of flanging or upsetting operations.

Engine Lathe: Weir Frog Co., Cincinnati, Ohio. A 24-inch quick-change double back-geared lathe built along the general lines of a lathe formerly manufactured by the Rahn-Larmon Co. The Weir Frog Co. has taken over the style D 24- and 26-inch lathes formerly made by the Rahn-Larmon Co.

Three-oven Furnace: American Incandescent Heat Co., Delta Bldg., Boston, Mass. A heat-treating furnace constructed on patented principles developed by Alfred Smallwood of Birmingham, England. The patent rights for this country have been obtained by the American Incandescent Heat Co.

Heavy-duty Lathe: Davenport Locomotive Works, Davenport, Ia. In the April number of MACHINERY, reference was made to a single back-geared engine lathe of this company's manufacture. A similar lathe is now being built which is furnished with a three-step cone pulley and double back-gears.

Screw Machine: Charles Stecher Co., Chicago, Ill. A plain head hand screw machine which is similar to the machine formerly built by this company except that power feed has been provided for the turret. Automatic stops are provided for use in handling repetition work. The machine swings 14 inches.

Shell Lathes: Hill Pump Co., Anderson, Ind. A line of heavy-duty turret lathes designed for work on the smaller sizes of shells. The machines are made in two sizes, known as Nos. 3 and 6, and simplicity of design is characteristic of both. The range of available speeds and feeds is ample for the class of operations for which these machines are intended.

Light Screw Machine: W. K. Millholland Machine Co., Indianapolis, Ind. A machine constructed along the same general lines as previous types of Millholland screw machines except that it is built lighter. The turret mechanism operates automatically. The hexagon turret has tapped holes to hold special fixtures in addition to tools that fit in the regular holes in its faces.

Punching and Riveting Machine: Vulcan Engineering Sales Co., 2059 Elston Ave., Chicago, Ill. A pneumatic machine for use in shops doing light work on which punching and riveting operations must be performed. The machine is made in two styles, one of which is mounted on a bench for stationary service, while the other is set up on a truck so that it may be conveniently moved about the shop.

Lubrication Pump: C. F. Roper & Co., Milford, Mass. A line of geared pumps for circulating oil, cutting compound or water to cutting tools and bearings on machinery. These are made in two styles, one of which is adapted for use on machines where the cutting tools work in only one direction, while the other is automatically reversed for use on machines where the tools cut in both directions.

Double-end Surface Grinder: Stenotype Co., Indianapolis, Ind. A double-end plain surface grinder adapted for handling the lighter classes of grinding met with in many lines of manufacturing. Both the table feed and cross feed are hand operated, and the screw dials are graduated to 0.001 inch. The table traverse movement is provided by a hand-lever. The double-end construction makes the machine very compact so that the floor space occupied is relatively small.

Oxy-acetylene Torches: Oxy-acetylene Torch Co., Greenfield, Mass. A line of cutting and welding torches. One noteworthy feature of the design consists of a roller attachment for guiding the torch over the metal when performing cutting operations. Both cutting and welding torches are provided with a "universal head" by means of which the flame may be swung through an angle of 270 degrees while the torch is in operation to enable the welder to reach easily any desired position on the work.

Heavy Punch and Shear: Cleveland Punch & Shear Works Co., Cleveland, Ohio. This is a universal machine provided with ample capacity for handling a variety of work, including multiple punching, shearing and pressing operations. The machine is heavily constructed and is provided with capacity for exerting pressure of 750 tons. The housings are each made of a single piece, and have a 15-inch gap; the bottom face of

the plunger is 30 inches wide, and it is provided with T-slots extending from front to back.

Factory Signal System: American Model & Instrument Co., Worcester, Mass. A fire alarm and individual call signal system for use in industrial plants. The instrument is controlled by the operator of the telephone switchboard and sounds bells, buzzers and horns in the factory to call the attention of any official who is away from his own office when wanted. This is known as the "Amico" universal industrial code signal system and is used to give fire alarms in addition to calling officials to the telephone.

Motor-driven Grinders: Standard Machine & Electric Co., Indianapolis, Ind. These grinders are of two types, one of which is driven by an alternating-current motor and the other by a direct-current motor; in other respects the design of both machines is essentially the same. An important feature of the design is that pushing down a foot-treadle closes the electric switch to start the grinding wheels rotating, and this switch is automatically opened when the operator leaves the machine. As a result the consumption of current is reduced to the amount actually required to drive the machine while it is in use.

Double-spindle Surface Grinder: Grayson Tool & Mfg. Co., Indianapolis, Ind. A double-end grinder fitted with separate spindles and mechanism so that it consists of two distinct machines mounted on a single base. This construction requires the use of a minimum amount of floor space and still allows two operators to work independently of each other. The main features of the machine consist of automatic and hand feeds, protection for all bearings, ample working stroke for the table, long knee bearing on the column, cushioned table stops, centralized control for each end of the machine, wipers for all slides and an effective lubricating system.

* * *

LOCATING TROUBLE

BY A. L. HAAS*

It is an axiom of research work, universally true but little realized in the shop and drawing-room, that in any investigation only one factor must be regarded as variable while the remainder are treated as constants for the time being. In other words, to pursue a number of clues to a successful issue, they should be dealt with singly and in due sequence. Often the reverse policy obtains; half a dozen matters are dealt with simultaneously, and when the trouble is eliminated there is uncertainty as to which alteration should be credited with the improvement. The argument that if the job is accomplished, the exact means are immaterial is wide of the mark. The experience and knowledge afforded by correct diagnosis is of the greatest future value. Indeed, if the exact means are not known the experience is totally wasted. If several alterations are effected together, these may mutually hamper each other. A single remedy among the number may be the correct specific; and the multiplicity of remedies that were tried may perhaps prove worse than the disease.

The worker having laboratory experience is sometimes criticized by the practical man for the slow methods of investigation he employs. To the true investigator exact knowledge is of relatively greater value than the individual problem in hand. Repetition of result from the same fundamental factors is the only method of knowledge on which to build further. The principle of "one thing at a time" is a counsel of patience that is at times difficult to follow. When one thing is under consideration for amendment, others subconsciously suggest themselves; the correct policy under the circumstances is to make a careful record of them, but keep to the immediate single issue. One of the commonest faults of a man with the inventive faculty is this tendency toward simultaneous action along several lines. The practical engineer is not so often troubled in this way; and in going over the work of the inventor, he is often tempted to amend several points on the job. In fact, it sometimes appears easier to reconstruct his idea entirely than confine attention to the troublesome details that must be changed.

The designer is often criticized for some detail which may seem easy to improve. What the critic at times fails to remember is the complexity of choice open; for some good and well considered reason, the detail with manifold drawbacks was retained, as it afforded an easy solution not vital to the job. However, it is not claimed that mistakes are not made over the drawing board or that the average designer is a mental superman, visualizing his work from every standpoint. Cut and try is the rule of the engineering universe, but it should be confined to a single issue for the particular occasion. The designer is as dependent upon the results in practice for future planning as any of the other individuals in the business who may be engaged in testing, outside erecting or in the machine shop. Troubles incidentally realized, unless fundamental, often fail to get back to their authors. Small adjustments are made, the job is completed and found satisfactory, but the experience afforded is not a vital matter and has a knack of evading the man who could apply the same remedy in the embryo shop on some future job.

In an ideal concern with a tactful and sympathetic management, it would be found that the designer was in touch with the man in the shop, the foremen, testers and erectors. The difficulty of adequate discussion is not unrealized, but unless the designer is faced with real criticism and to some extent forced to declare his reasons, he may travel on in happy ignorance to the detriment of the products made from his designs. Take, for example, the question of governing oil engines, which is one of the thorniest questions of design. Several successful systems are in operation, all of which depend upon mechanism of a delicacy unparalleled elsewhere for similar purposes. A valve with a total lift of 0.010 inch has this lift variable. In conjunction with this, is a full pump with a shock stroke—in fact, a liberal blow. The whole mechanism is controlled by a necessarily sensitive governor. The conditions to be met are difficult, the mechanism for considerations of inertia must be slight, even flimsy, and the economic success is made or marred by minute adjustments on the test bed. The difference made by inferior tuning up may amount in an engine to hundreds of gallons of oil per annum, between one engine and its duplicate. Ability to obtain the most economical results is, in this instance, independent of both the shop and the designer. It demands experience coupled with an endowment of the scientific spirit on the part of the specialist. To alter more than one adjustment at a time would be fatal. The difference in the results obtained by the adjuster is largely due to a realization of the doctrine of non-interference, except with a single variable at a time.

It may be broadly stated that the entire field of metal working lies in patient attention to minute details, and, in the case of trouble, the detection of the smallest of these may be the cornerstone of ultimate success. For this reason alone, leaving out altogether the attraction that mechanism possesses, the trade will always have perennial interest. This explains why actual experience bulks so largely in the equipment of the engineer. Skill in its broadest aspect is compounded of experience wedded to detail, while mechanical judgment that is correctly catalogued among the rare virtues, is built upon a similar foundation. Whether the subject be the design of important plants or machines, or the more detailed work of the shop, economies can be effected, troubles located and complexities simplified by the combination of experience with the right attitude of mind, and by observing the principle of "one thing at a time."

* Address: 146 Crowborough Road, London, S. W., England.

* * *

A wise policy is of more avail than a large plant; good management, than perfect equipment. * * * The factory invariably reflects the manager. The special problem of today is, then, to select and train, or rather, to train and select, our industrial leaders. * * * The possession of wealth, and hence power, does not necessarily fit a man for leadership. * * * The scientific method thrives best when all have equal opportunities, and our chances of getting proper industrial leaders is far greater when we have a whole people to choose from, than when they are selected from any one class.—*H. L. Gantt, in Industrial Leadership.*

* * *

The Ford Motor Car Co. built 58,329 cars in the month of March, the largest production record in its history. On March 25, the company turned out 2763 cars, the largest day's production. This was at the rate of nearly two a minute for twenty-four hours.

CUSTOMS INFORMATION

DECISIONS ON SEWING MACHINE NEEDLES, BEET KNIFE SHARPENERS, STEEL STRIPS, AND PROTESTS ON CAST-IRON VESSELS FOR RETORTS

BY JULES CHOPAK, JR.*

The Board of General Appraisers considered the question of the proper duty on so-called "Randall" needles, which the evidence showed were especially constructed and designed for harness-making, and that their use in connection with shoemaking was incidental and exceptional, and reached the conclusion that they were sewing machine needles. They were classified for duty by the government at the rate, 20 per cent, taken on sewing machine needles, paragraph 135 of the tariff act. The importers protested this assessment, claiming that the needles were free of duty, under paragraph 555, which admits without duty, when imported, "needles, hand sewing and darning, and needles for shoe machines." The importers' claim was based upon the last clause of the free list paragraph, on the theory that the use in shoe machines made the needles free of duty.

Questions of this sort for tariff interpretations have always been very close. While the articles are "needles for sewing machines," still if they are "needles for shoe machines"—a special kind of sewing machine—they are more properly classifiable under the more narrow and limited clause. When it is found that the use is not exclusive, or even that the articles are not especially adapted for use on shoe machines, but may be used on harness machines—sewing machines—then the question of the extensiveness of the respective uses has a very important bearing. The rule is not altogether uniform, but the weight of the authorities is that the exclusive use, or chief use, or special construction for use in shoe machines, makes the articles dutiable as such. In this case, it was found that the special construction and adaptability was not for shoe machines, and that that use was rare. Hence the claim was not allowed.

Steel Strips Not Sheets

Another case passed upon by the Board was cold-rolled high-carbon steel, 6 feet long, $5\frac{1}{2}$ inches wide, and $\frac{1}{8}$ inch thick. It was classified for duty at 15 per cent under paragraph 109, as steel "sheets." The importers claimed that the proper duty should be 12 per cent under paragraph 105 on the ground that the merchandise was not sheets but strips. Paragraph 105 provides for "strips of steel not specially provided for." The clear-cut issue made was whether or not merchandise bearing the above dimensions was sheets or strips. The Board held it was strips, lowering the duty accordingly. This decision opens up a point which does not seem to have been considered; that is, if $\frac{1}{8}$ inch thickness is correct for a "strip." In other words, would a strip be thinner, such as No. 15 wire gage, or about 1/14 inch? It may very well be that strips do not come so thick, although sheets do, of course. The decision also opens up an incongruity in the tariff law, doubtless overlooked by Congress, for it makes an article of greater width and thickness, with a probable greater value, dutiable at a less rate than is charged on the same article having slightly smaller dimensions. Paragraph 114 takes 15 per cent duty on "steel in strips not thicker than No. 15 wire gage (about 1/14 inch) and not exceeding 5 inches in width, whether in long or short lengths, in coils or otherwise, and whether rolled or drawn through dies or rolls, or otherwise produced." The merchandise in question would undoubtedly be classified here if it were not so thick and so wide. But if it is more valuable than that which is not thicker than 15 wire gage and not over 5 inches in width, then why should it pay less duty? Of course, this is a question to be addressed to Congress for consideration in revising the present tariff law.

Beet Knife Sharpeners

The Board of General Appraisers followed a decision of the Customs Court at Washington, holding that circular steel files known as "fraises" used to sharpen the knives and blades of beet slicing machines, were free of duty under paragraph 391, exempting from duty "machinery for use in the manufacture of sugar." The "fraises" do not directly enter into the manufacture of sugar, but the Court gave the clause a broad construction, taking in everything which might have an incidental use. The beet slicing machines have a direct relation to manufacturing sugar, but are not of use unless the blades, when dulled, are sharpened. Under this decision, then, the sharpeners are exempt from duty, too.

Protests Now Under Consideration

Protest: Large cast-iron vessel, used in retorts, machined. *Assessed:* 20 per cent under paragraph 167 as manufactures of metal. *Claim:* 10 per cent under paragraph 125 as cast-iron pipe, and all castings of iron which have been machined or otherwise advanced in condition by processes or operations subsequent to the casting process, but not made up into articles or finished machine parts.

The protests of this class involve a legal question, simply, of a clear statement of facts which includes the latter part of the castings classification. What does the expression "but not made up into articles or finished machine parts" mean, as applied to this case? Here we have a large casting which was machined. Was it "made up into articles"? This paragraph might be understood to mean that the castings which are parts of an article are dutiable at 10 per cent, if they are not finished or already made up. That view carried a little further would be that single cast articles are excluded. This is not very certain for a fair reading of the entire clause, which opens by saying "all castings." "All castings" cannot exclude and include one-piece castings at the same time.

The 20 per cent rate, under the classification of manufactures of metal not especially provided for, has no special value for application. The clause is merely a basket, open and standing ready to receive anything which cannot be classified elsewhere. These articles will take that duty only if the castings provision appears not to cover. While the language of paragraph 125 could be more clear and greatly improved upon, reading it fairly as it is, there is some merit to the claim that this cast vessel is within its terms. However, the thoughts of the judges who decide the case, their liberality or strictness, will largely govern the decision.

* * *

SCIENTIFIC MANAGEMENT IN GOVERNMENT WORKSHOPS

A committee of ten engineers headed by Henry R. Towne, chairman, has been organized to oppose legislation antagonistic to efficiency in American industry. The committee has issued a pamphlet entitled "A Call to Arms," in which attention is drawn to certain legislation now pending in Congress. The Tavenner bill provides that it shall be unlawful for any officer, manager, superintendent, foreman or other person having charge of works of any employe of the United States Government to make time studies with a stop watch or other time measuring device. The bill provides that no premium or bonus or cash award shall be paid to any employe in addition to his regular wages, except for suggestions resulting in improvement or economy in the operation of any government plant. The Vandyke bill is of similar tenor.

In reviewing the matter, the pamphlet states that labor, material, and expenses or overhead are the three factors embracing the cost of every product. Scientific management is a term used to designate the application of scientific methods, the human efficiency to benefit the employe by lightening labor, augmenting output and by increasing earnings, and to benefit the employer by augmenting the output of his plant and thus decreasing the cost of products. In view of the mutual advantages that accrue from improved methods of manufacture, the better utilization of human effort and the increased productiveness of investment in machinery and plants, the objection of labor leaders, legislators and others to scientific investigations of manufacturing methods seems absurd. To forbid the government by law to purchase materials made in an establishment where scientific management is used, would compel the government to use materials made in the least progressive and efficient plants, often, if not always, at higher costs. It would tend to discourage instead of encourage American manufacturers in preparing to meet the competition of other countries.

* Customs Lawyer, 29 Broadway, New York City.

FOREIGN TRADE OF JAPAN AND UNITED STATES

SOME CHANGES IN TRADE CONDITIONS RESULTING FROM THE WAR

When the Choshu clan started the revolution that has since been recognized as the awakening of Japan, it took for its motto, "Japan, Strong for Defence and Aggression." To attain this end it carefully studied European and American methods and tried to adopt those that it thought were the best; the result is seen in the commercial development of the nation. It doubled its foreign trade in the eight years preceding the war with China while in the twenty years preceding the war with Russia its share of the world's trade increased from 0.4 to 1.5 per cent. During this same time Germany's share grew from 10 to 11.3 per cent; the United States, from 9.01 to 10.5 per cent; and Great Britain's fell from 12.8 to 10.8 per cent. But it is since that war that Japan's foreign trade has attained its greatest growth, for the results of the war gave the nation a new outlook and its statesmen new ambitions.

The development of Japan's aggressive strength is shown by the fact that if the Pacific mail steamers had been withdrawn last November, of the 490,000 tonnage that would then be available in the Pacific, Japan owned and controlled, through subsidies, 430,000. As a result of this control, cargo space to all Asiatic ports has been held at a high premium, for most of the space in the Japanese boats has been reserved by the government for goods shipped to and from the ports of Japan. One magazine writer recently said: "The present war has been Japan's opportunity. She has been a diligent reaper, but she has not yet got her reapings safely housed, nor is she convinced that the opportunity is exhausted. The period from now to the end of the war marks, perhaps, the crisis of Japan's existence as a world's power, when she must either firmly grasp her opportunity or see her ambitions fade forever." Whether or not this is true, Japan is now obtaining a large share of the world's trade. Although normally its imports exceed its exports by several millions, in 1915 its exports were larger by about $84,000,000. One result of this expansion of Japan's foreign trade is, according to Dr. Frederick Starr, of the University of Chicago, that over 1000 millionaires have been created since the European war began. The *New Zealand Herald* says:

> There is hardly a manufactured article that Japan is not turning out at the present time, and she makes no secret of the fact that she is endeavoring to get a strong hold on the world's markets, especially those that were formerly flooded with German goods. There have arrived in Wellington goods that prior to the war Japan had not attempted to manufacture; these include ironmongery and such implements as garden tools (which are evidently intended to be a replica of the American-made article), locks, shelf brackets, sash rollers, hasps and staples, leather purses (all grades and varieties), scents and soaps, lead pencils, ink, erasers, stationery of all kinds, fountain pens, surgical and rubber goods (such as hot-water bottles), barbers' instruments, vacuum flasks, Panama hats, basket ware, and suit cases. In brush ware the Japanese have made great strides, and they are now going in for the better quality of article.

Not only does the Asahi Glass Co. now supply the domestic demand but it sells one-half of its output in foreign markets. The demand for Japan's paper is so great that several of its mills are planning to enlarge their plants, especially to supply the Chinese markets, and also to manufacture their own wood pulp. The export of Portland cement, started after the outbreak of the war, averages from 50,000 to 100,000 barrels a month to Australia, the Dutch Indies, British India, and other Eastern countries. Last year, Japan's exports of shell buttons, mostly to European countries, increased in value $529,000; its toys are sent to England, Australia, India, and North and South America. Seventy, and not forty, per cent of its ceramic ware is now sent to foreign markets. Besides, in its production, machinery has replaced hand labor, the kilns have been improved, and coal is used, so that a former week's output is now obtained in a day. Japan's flour is being shipped to England and the South Sea Islands, and its control of the China trade, through the Mitsui Co., was one of the reasons why the United States shipments to Chosen fell from $583,788, in 1914, to $84,824 in 1915, while Japan's shipments increased from $851 to $106,160, and China's from $2754 to $111,483. The products of its nine hundred match factories, with an annual output of $7,470,000, may now be bought in England and are rapidly being introduced in most other countries; men returning from Mexico speak of the aggressive advertising campaign for this match now being carried on there. While many match factories are being started in China, they are completely dominated by the Japanese interests, as the Chinese must buy all of their supplies from Japan.

In order to develop its trade in southeast Manchuria as thoroughly as possible, Japan has erected, in Antung, China, with Japanese workmen and from Japanese materials, a building in which it will exhibit goods manufactured in Japan and the agricultural and mineral products of that part of China. In the erection of this museum, the effort has been made to show as many as possible of the uses of the various materials employed. To aid the development of its Chinese trade, the Manchurian Bank has been opened, in Mukden, with a capital of $4,985,000 and the Sino-Japanese Bank, in Shanghai, with a capital of $9,970,000. The director of agriculture and commerce is now advising all Japanese manufacturing companies that must spend much money on their plants or in finding markets in China to erect plants in China. He says, "The valley of the Yangtze is destined to become the center of the industrial activities in the East when the time comes for the East to awaken to new industrial activities," and states that all lines of industry ministering to the daily needs of the people, such as spinning, weaving, flour mills, glass and soap making, printing, iron work, the working of blown metal, ship building, etc., are most promising and have a good future.

Japanese cotton goods are rapidly supplanting those of England in the South Sea Islands and the Indies, and have entered New Zealand, Australia, and Africa; its mills have also begun the manufacture of the higher counts of thread and the finer cloth. Its shipyards have steadily increased in size and ability until they can produce almost any vessel desired. Aided by the government's subsidies, dye works and laboratories for the preparation of medicine are being erected. Great Britain's consul-general at Kobe says: "The making of machinery is increasing yearly and the demand for oil and gas engines is met largely by locally made machines. Since the outbreak of the war the difficulty which British firms experience in accepting orders for prompt delivery has diverted here many orders that might have been expected to go to Great Britain. The war has also revolutionized the refining of zinc in Japan. It is expected that when all the works now planned are in working order they will handle the nation's entire output of zinc ore."

An effort is now being made to develop the wool industry, although the native grasses are not suitable for pasturage; the Imperial stock farm at Hokkaido recently purchased for this purpose a large number of sheep from Australia and New Zealand. An effort is also being made to control the mineral development of Chosen by the enactment of mining laws that confine the management of such works to citizens of Japan. The sale of Japanese goods in New Zealand has increased so rapidly that Japan is planning the establishment of a steamship line between the two countries by way of Australia, while the diversion of Japanese steamers from the Suez Canal route around the Cape of Good Hope has resulted so favorably to Japan's trade with South Africa that a line will connect African and Japanese ports even when the Suez Canal route is again available. It is also reported that, besides buying immense quantities of munitions from Japan, Russia has been making efforts to obtain a loan of $75,000,000.

In 1915, Japan's total exports to the United States, the Philippine Islands, and Hawaii, amounted to $116,305,202. Of this, $3,147,339 was for copper ingots and slabs; $69,233,318 for silk; $693,192 for beans and peas; $886,521 for maize; $1,897,659 for cotton goods; $3,380,765 for hemp, chip, and straw braids; $6,000,756 for tea; $637,055 for brushes and feather dusters; $419,508 for toys.

Results of War on United States

The past two years have also seen the foreign trade of the United States grow; but this growth has been in spite of obstacles caused by the war rather than from the development of carefully studied plans for such an emergency. The beginning of the war found this nation depending almost entirely on foreign vessels for the transportation of its goods; now it is rapidly building up a merchant marine of its own and its flag is now seen in most of the world's ports. It was dependent on other nations for banking facilities outside of its own boundaries, now it is opening its own banks in Central and South America and is planning to open some in Europe. It was largely dependent on foreign importers for its sales in foreign markets; now it is selling direct. Its capital indebtedness to the Old World is diminishing so rapidly that soon it will be negligible. At the same time it has lent capital to the Entente Alliance, $500,000,000 in one transaction, and to France, South American countries, Canada, Switzerland, and Scandinavia. Besides, it has loaned the credit of its vast banking resources to various countries, directly and indirectly. It has not only cancelled its indebtedness abroad but it has created a foreign debt on which the United States will receive interest and dividend. It now has the largest stock of gold that, so far as is known, was ever owned by one people. The aggregate resources of its national banks at this time are $3,000,000,000 greater than the aggregate resources of the Bank of England, the Bank of France, the Reichsbank of Germany, the Bank of Russia, the Bank of the Netherlands, the Swiss National Bank, and the Bank of Japan. In fact, the American dollar has supplanted the English pound as the unit of foreign trade to such an extent that the Pan-American Conference, in April, decided to make the unit of all Pan-American commerce "a weight of gold exactly one-fifth of the value of the United States gold dollar."

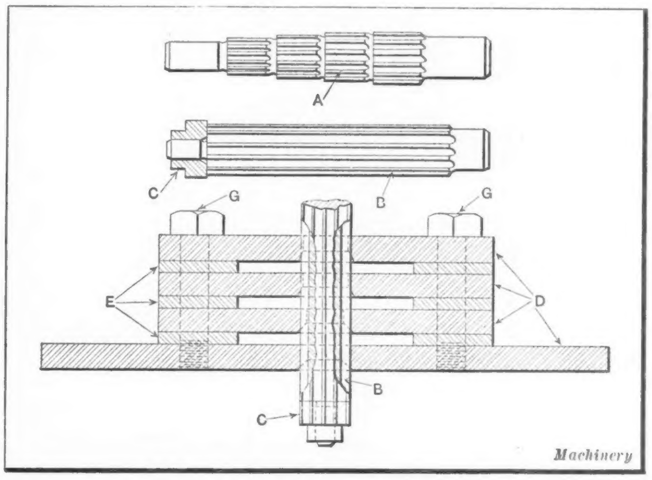
American goods are in demand all over the world. The United States is now the largest exporter of manufactured goods; the value of its exports of manufactured products in 1915 was $1,784,000,000, or $350,000,000 more than Great Britain's. Japan cannot operate its extensive shipyards without American steel, and she must buy American cotton for the manufacture of her finer cloth. Italy, Russia, France and Spain are constantly seeking American steel and steel products; they are also studying American factory methods so as to reorganize their industries along the most efficient lines possible when peace is restored. Twenty Chinese naval officers and cadets and one captain and six lieutenants of the Spanish navy are studying the methods of the New London Ship & Engine Co.

In April, England purchased 100,000 tons of copper, although it had purchased 60,000 tons only last fall; while the bulk of this will be used in the manufacture of munitions, a large part is also necessary for the British ships now being built. An investigator for the Bureau of Foreign and Domestic Commerce says that for several years the United States will be called upon to supply South America annually with from 750,000,000 to 1,000,000,000 board feet of lumber for use in finishing buildings. Twelve vessels will be required to transport to Russia the cut lumber recently purchased by that nation. Most of the New Zealand shoe factories are equipped with American shoe machinery and one American firm last year increased its sales of farm machinery in New Zealand $100,000. An American syndicate has opened manganese mines at Madinga on the Gulf of San Blas, Colon, Panama, about seventy miles east of Colon, from which it has shipped 900 tons to New York, and, when vessels are available, will mine 1500 tons a month. Ten thousand tons of American cast-iron pipe will be used in the construction of an aqueduct in Uruguay, which proposition a New York bank is financing. Twenty million pounds of tobacco was sold by one American firm to European countries in April, while last year 67,576,800 pounds of rice were sold in foreign markets, the larger part being markets that were formerly supplied by English exports. New financing for concerns manufacturing war munitions, dye stuffs and chemicals, and engaged in the shipping business has involved capital issues of $625,276,000; and importers in Australasia and Spain are urging the formation of steamship lines between the United States and those countries. D. E. J.

BROACHING METHOD OF MANUFACTURING SPUR GEARS

Herman W. Martin, 7 E. 42nd St., New York City, is developing a process of producing spur gears by which, he states, the cutting of the teeth can be done for less than half the cost of present methods. Various details in connection with the tools and method used for a small brass pinion are shown in the accompanying illustration. Briefly, the process is one of forcing the gear blanks through a series of serrated plates which are progressively arranged so that each plate takes off a predetermined amount of material—in short, broaching the gears with external broaches or dies.

An interesting feature in the process is the manufacture of the die-plates. A blank *A* is turned up to form a series of cylindrical steps, the smallest of which is used for the first die-plate, while the intermediate and largest steps are used to produce the other plates. After the cylindrical work has been done on the cutter blank the teeth are milled to correspond with the pitch of the gear required and the broach is hardened ready for use. The lower illustration in the figure shows the assembled drawing plates *D*. These plates are broached by the



Broaching Dies for cutting Spur Gear Teeth

tool *A* so that they operate on the work progressively, the upper and intermediate plates each taking out a small amount of metal while the lower one finishes the work. The spacing plates *E* which are interposed between the die-plates allow the chips to work out and also provide air space so that the heat generated by friction will radiate readily. The plates are made of machinery steel and are carburized and hardened, after which the upper surfaces surrounding the holes are ground to a cutting edge. The plates are bolted together by the bolts *G*, suitable dowels being used to keep them in alignment. Mr. Martin states that this process can also be applied to a bar from which the pinions can be cut off after they have been machined. A description of a process somewhat similar to this appears in MACHINERY for April, 1914, on page 673, in an article on "Commercializing a Process by Means of Press Work," by Chester L. Lucas.

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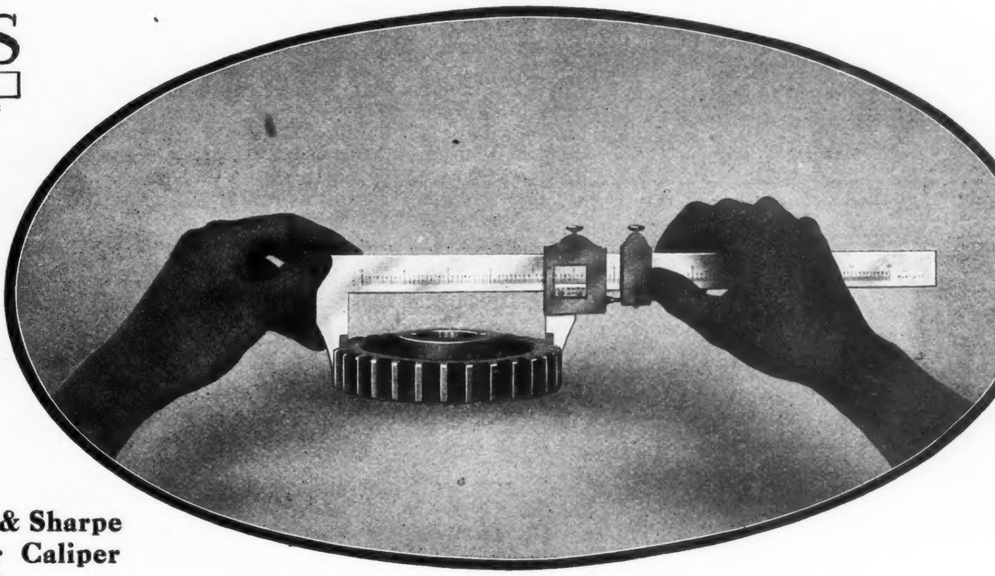
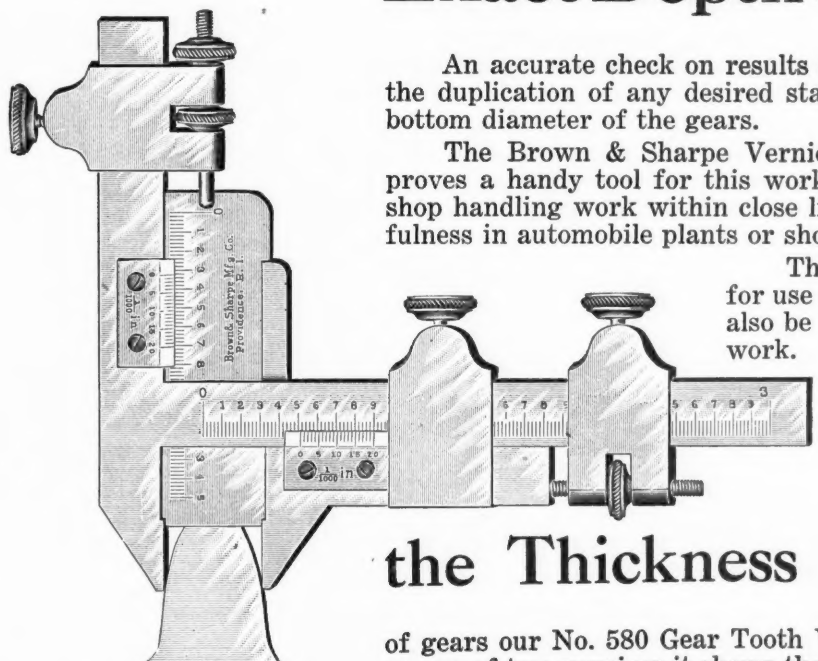
The annual report of the Fried. Krupp A. G., of Essen, Germany, for 1914-1915, states that the net profits for the year amounted to about $21,500,000, as compared with $8,400,000 in the preceding year. The large requirements of war material during the year increased the total amount of business done to nearly two and one-half times the corresponding total in the previous year. The growing demands on the capacity of the firm necessitated large extensions to the plant. For this reason a further increase of the capital was necessary, amounting to about $8,500,000. The capital stock during the year covered by the report was about $53,000,000, and the net surplus about $24,000,000. During the year about $4,000,000 was turned over to benevolent funds, including war allowances. A dividend of 12 per cent was declared, the remainder of the profits being added to the surplus. It has been decided to create a "Krupp Foundation," which will favor large families of fallen or severely wounded soldiers, the fund amounting to $5,000,000.

B·S
TRADE MARK



Brown & Sharpe
Vernier Caliper
No. 573

For Determining the Exact Depth of Gear Teeth



An accurate check on results in gear cutting, one which insures the duplication of any desired standard, is found by measuring the bottom diameter of the gears.

The Brown & Sharpe Vernier Caliper No. 573, shown above, proves a handy tool for this work. It is especially valuable in any shop handling work within close limits and finds a wide field of usefulness in automobile plants or shops cutting transmission gears.

The jaws of the vernier are made thin for use of fine pitch gears but the tool may also be used like our 12″ Vernier on other work.

For Measuring the Thickness of the Teeth

of gears our No. 580 Gear Tooth Vernier is handy and reliable. By means of two verniers it shows the distance from the top of the tooth to the pitch line, and the thickness at the pitch line.

By the use of this vernier, compensation may be made for variation or error in the size of the gear blank. Write for our No. 26 Catalog.

Gear Tooth Vernier
No. 580

Mfg. Co., Providence, R. I., U. S. A.

Hammond Co., Cleveland, O., Detroit, Mich.; Colcord-Wright Machinery & Supply Co., St. Louis, Mo.; Perine Machinery Co., Seattle, Wash.; Portland Machinery Co., Portland, Ore.

CANADIAN: The Canadian-Fairbanks-Morse Co., Ltd., Montreal, Toronto, Winnipeg, Calgary, Vancouver, St. Johns, Saskatoon.

FOREIGN: Buck & Hickman, Ltd., London, Birmingham, Manchester, Sheffield, Glasgow. F. G. Kretschmer & Co., Frankfurt a.M., Germany; V. Lowener, Copenhagen, Denmark, Stockholm, Sweden, Christiania, Norway; Schuchardt & Schutte, Petrograd, Russia; Fenwick Freres & Co., Paris, France, Liege, Belgium, Turin, Italy, Zurich, Switzerland, Barcelona, Spain; F. W. Horne Co., Tokio, Japan; L. A. Vail, Melbourne, Australia; F. L. Strong Machinery Co., Manila, P. I.

CONFERENCE ON ENGINEERING COOPERATION

The second conference of the committee on engineering cooperation was held in Chicago, April 13 and 14, and was attended by representatives of forty-two national, state, and local engineering and technical societies from all parts of the United States. The purpose of the conference was to bring about a closer relation among engineers and engineering organizations, to discuss ways to improve standards of engineering practice and to gain a clearer recognition of the engineer as a civic asset. Prof. F. H. Newell of the University of Illinois was chairman and C. E. Drayer, secretary of the Cleveland Engineering Society, was secretary of the committee on engineering cooperation which had the meeting in charge. Subjects discussed were practicability and limits of cooperation, employment, ethics and legislation. Cooperation from the standpoint of the state society was presented by Paul Hansen and Clyde T. Morris; from the standpoint of the national societies the subject was presented by P. Junkersfeld, Horace C. Gardner, DeWitt V. Moore, J. F. Hale, C. H. McDowell and John H. Peyton. The subject was presented from the standpoint of the local society by F. G. Gasche, A. J. Himes, H. L. Keck and Lewis R. Ferguson. C. E. Drayer gave an illustrated talk on publicity for engineers.

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SPRING MEETING OF A. S. M. E.

The spring meeting of the American Society of Mechanical Engineers was held in New Orleans, La., April 11 to 14, inclusive. The visiting members were the guests jointly of the Louisiana Engineering Society, the New Orleans association of members of the American Society of Civil Engineers and the local membership of the American Society of Mechanical Engineers. The headquarters were at the Hotel Grunewald.

The program, as usual, began with registration and an informal reception Tuesday evening. On Wednesday, the paper "Organizing for Industrial Preparedness" was presented by Spencer Miller and was followed by an extended discussion. The paper emphasized the importance of the industrial census of the country, to be undertaken by representatives of five of the national engineering societies at the invitation of President Wilson. On Wednesday afternoon, the members and friends took a boat trip to inspect the harbor and the recently constructed cotton warehouse which is unusual in its mechanical equipment. Other engineering works of interest were also seen. In the evening, W. B. Thompson, commissioner of public works of the City of New Orleans, addressed the members, and on Thursday the following papers were presented, followed by discussions:

"Capacity and Economy of Multiple Evaporators," by E. W. Kerr.

"The Evolution of Low-lift Pumping Plants in the Gulf Coast Country," by William B. Gregory.

"Mechanical Equipment used in the Port of New Orleans," by William von Phul.

On Thursday afternoon, the visiting members and guests were given an opportunity of visiting the New Orleans Country Club, and in the evening a reception and dance was attended. On Friday, the following papers, followed by discussions, were presented:

"Establishing a Standard of Measurement for Natural Gas in Large Quantities," by Francis P. Fisher.

"Deviation of Natural Gas from Boyle's Law," by Robert F. Earhart and Samuel S. Wyer.

"Some Experiments on Water-flow through Pipe Orifices," by Horace Judd.

"Dynamic Balance," by N. W. Akimoff.

"The Measurement of Viscosity and a New Form of Viscosimeters," by H. C. Hayes and G. W. Lewis.

"On the Transmission of Heat in Boilers," by E. R. Hedrick and E. A. Fessenden.

On Friday afternoon, an excursion was made to the reclaimed lands near New Orleans to inspect the extensive tracts that had been reclaimed and turned to useful purposes.

PERSONALS

Thomas J. Egan, formerly of the Dexter Folder Co., Pearl River, N. Y., has taken the position of superintendent of the Brown Cotton Gin Co., New Haven, Conn.

J. T. Smoody, formerly of the engineering department of the American Thread Co., has joined the staff of the Chile Exploitation Co., 120 Broadway, New York City.

Alexander C. Brown, vice-president of the Brown Hoisting Machinery Co., Cleveland, Ohio, has been appointed general manager, succeeding Richard B. Sheridan, who has resigned to take another position.

J. B. Doan has been elected president of the American Tool Works Co., Cincinnati, Ohio, succeeding the late Franklin Alter. Robert S. Alter has been elected vice-president and foreign manager, and Henry Luers, treasurer.

William S. Chase, formerly sales manager of the National-Acme Mfg. Co., Cleveland, Ohio, was married April 12 to Ada B. Parrish, at Alhambra, Cal. Mr. and Mrs. Chase will live on their ranch at Del-Ca-Mar, Meridian, Idaho.

The many friends of Vernon Job, manager of the Western office of the Independent Pneumatic Tool Co., 61 Fremont St., San Francisco, Cal., will be pleased to learn that he is rapidly recovering from an attack of appendicitis.

W. V. Houck, assistant superintendent of the King Sewing Machine Co., Buffalo, N. Y., has taken a position as factory manager with the Sterling Engine Co. of Buffalo. Mr. Houck was with the Garvin Machine Co. of New York for ten years.

W. L. Schellenbach, for several years chief engineer with the Lodge & Shipley Machine Tool Co., Cincinnati, Ohio, has taken offices at 520 First National Bank Bldg., Cincinnati, where he will devote himself to consulting engineering and machine design.

OBITUARIES

Victor A. King, a well-known gunmaker who was for seven years superintendent of the Winchester Repeating Arms Co., New Haven, Conn., died at his home in West Haven, March 19, aged eighty-nine years. Mr. King went to New Haven in his youth and was employed by the old Whitney Arms Co. in Whitneyville, Conn. At that time, he worked on the first order of Colt's revolvers ever made.

COMING EVENTS

May 10-12.—Triple convention of the Southern Supply and Dealers Association, the National Supply and Dealers Association and the American Supply and Machinery Manufacturers Association, at Pittsburg, Pa. William Penn Hotel, headquarters.

May 11-13.—Conference on scientific management at Ann Arbor, Mich., under the auspices of the Taylor Society. The conference is to be held at the University of Ann Arbor. Secretary, Henry W. Shelton, 35 College St., Hanover, N. H. Reservations in charge of Prof. Joseph A. Bursley, University of Michigan, Ann Arbor, Mich.

May 16-17.—Annual meeting of the National Association of Manufacturers at the Waldorf-Astoria Hotel, New York City. George S. Boudinot, secretary, 30 Church St., New York City.

May 22-27.—Third national safety exposition of the American Museum of Safety at the Grand Central Palace, New York City. Arthur Williams, president, and Dr. William H. Tolman, director, 18 W. 24th St., New York City.

June 12-16.—Midsummer cruise of the Society of Automobile Engineers on the Steamship "Noronic," leaving Detroit June 12 and returning June 16. Reservations can be made by application to W. H. Conant, treasurer, 601 Kerr Bldg., Detroit, Mich.

June 14-16.—Annual meeting of the Master Car Builders Association at Atlantic City, N. J. J. W. Taylor, secretary, 1112 Karpen Bldg., Chicago, Ill.

June 14-21.—Annual meeting of the Railway Supply Manufacturers Association at Atlantic City, N. J., in connection with the A. R. M. M. and M. C. B. Associations. J. D. Conway, secretary and treasurer, 2136 Oliver Bldg., Pittsburg, Pa.

June 19-21.—Annual meeting of the American Railway Master Mechanics Association at Atlantic City, N. J. J. W. Taylor, secretary, 1112 Karpen Bldg., Chicago, Ill.

June 27-July 1.—Annual meeting of the American Society for Testing Materials at Atlantic City, N. J. Hotel Traymore, headquarters. Edgar Marburg, secretary, University of Pennsylvania, Philadelphia, Pa.

August 15.—Annual meeting of the International Railroad Master Blacksmiths Association, Chicago, Ill. A. L. Woodworth, secretary and treasurer. C. H. & D. Ry., Lima, Ohio.

September 5-8.—Annual convention of the Traveling Engineers' Association at Chicago, Ill. W. O. Thompson, secretary, New York Central Car Shops, E. Buffalo, N. Y.

September 11-16.—Annual convention of the American Foundrymen's Association and the American Institute of Metals, Cleveland, Ohio, in the Cleveland Coliseum. A. O. Backert, secretary-treasurer, American Foundrymen's Association, Cleveland, Ohio.

SOCIETIES, SCHOOLS AND COLLEGES

Clarkson College of Technology, Potsdam, N. Y. Bulletin for 1916 containing calendar 1916-1917 and outline of courses.

Northwestern University, Evanston, Ill. Annual catalogue 1915-1916 containing calendars for 1915-1916 and 1916-1917.

School of Mines and Metallurgy, University of Missouri, Rolla, Mo. Catalogue 1915-1916 containing calendar for 1916-1917.

Lowell Textile School, Lowell, Mass. Annual report of the trustees of the Lowell Textile School, for the year ended June 30, 1915.

National Association of Manufacturers, 30 Church St., New York City. Proceedings of the International Trade Conference held under the auspices of the National Association of Manufacturers of the United States of America in cooperation with banking and transportation interests of the United States, at New York City, December 6 to 8, 1915. The object of the conference was to consider ways and means for facilitating international transactions which had been seriously interrupted by the war. The principal problems dealt with related to transportation, credit and exchange.

Conference Board of Safety and Sanitation, Magnus W. Alexander, secretary, West Lynn, Mass., is issuing a periodical entitled "The Spirit of Caution," which deals with fundamental factors of safety and sanitation problems as encountered in industries generally. This publication is prepared primarily for the attention and guidance of managers, superintendents and foremen, but the distribution among employes generally will develop a wholesome regard for the effective prevention of accidents. Shop posters have been prepared to assist in the prevention of accidental injuries and to promote proper treatment of wounds. These can be obtained from the Conference Board. The April number of "The Spirit of Caution" discusses the "careless habit" and shows illustrations of common accidents that result from the carelessness of the workmen.

NEW BOOKS AND PAMPHLETS

Effect of Certain Pigments on Linseed Oil. By E. W. Boughton. 16 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper of the Bureau of Standards No. 71.

General Design of Critically Damped Galvanometers. By Frank Wenner. 34 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper of the Bureau of Standards No. 273.

Leakage of Currents from Electric Railways. By Burton M'Collum and K. H. Logan. 51 pages, 7 by 10 inches. Illustrated. Published by the Department of Commerce, Washington, D. C., as Technologic Paper of the Bureau of Standards No. 63.

Standardization of Automobile Tire Fabric Testing. By Walter S. Lewis and Charles J. Cleary. 18 pages, 7 by 10 inches. Illustrated. Published by the Department of Commerce, Washington, D. C., as Technologic Paper of the Bureau of Standards No. 68.

Modern Practice in the Construction and Maintenance of Rail Joints and Bonds in Electric Railways. By E. R. Shepard. 122 pages, 7 by 10 inches. Illustrated. Published by the Department of Commerce, Washington, D. C., as Technologic Paper of the Bureau of Standards No. 62.

Standard Test Specimens of Zinc Bronze. Part I.—Preparation of Specifications. By C. P. Karr. Part II.—Microstructure. By Henry S. Rawdon. 67 pages, 7 by 10 inches. Illustrated. Published by the Department of Commerce, Washington, D. C., as Technologic Paper of the Bureau of Standards No. 59.

Concrete on the Farm and in the Shop. By H. Colin Campbell. 149 pages, 5 by 7¼ inches. 51 illustrations. Published by Norman W. Henley Publishing Co., New York City. Price, $0.75.

This is a practical treatise on everyday uses of concrete for inexperienced persons desiring to make their own concrete structures. It describes the construction of tanks, troughs, cisterns, fence posts, stable floors, hot-beds, walls, foundations, panel fences, etc.

Invar and Related Nickel Steels. 68 pages, 7 by 10 inches. Illustrated. Published by the Department of Commerce, Washington, D. C., as Circular of the Bureau of Standards No. 58.

This circular is chiefly a compilation (from sources which are often inaccessible) of the properties of nickel steels with particular reference to the properties of the non-expanding alloy known as "invar." It contains chapters on the magnetic, electrical, thermal and mechanical properties, applications, sources, and brief statements on microstructure and constitution.

Standard Density and Volumetric Tables. 67 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Circular of the Bureau of Standards No. 19.

The wide application of hydrometers as measuring instruments in the industries makes it very important to define the various scales of indication of these instruments in terms of fundamental units. In this circular the conditions are announced under which the testing of hydrometers will be conducted and specifications are given as to the construction, standardization and accuracy required for hydrometers in order that they may be approved as precision instruments.

Location of Engine Cooling and Lubrication Troubles Made Easy. By Victor W. Page. Chart, 24 by 30 inches. Published by Norman W. Henley Publishing Co., New York City. Price, $0.25.

This combination chart shows all components of the approved form of water cooling group as well as of a modern engine lubrication system. All points where defects exist that may result in engine overheating both in cooling and oiling systems are shown. The defects in the cooling systems may occur in the radiator, circulating pump, water piping, cooling fan and engine. Oil system defects are analyzed, giving the symptoms, trouble and remedy, the same as in the cooling system.

Magnetic Testing. 50 pages, 7 by 10 inches. Illustrated. Published by the Department of Commerce, Washington, D. C., as Circular of the Bureau of Standards No. 17.

Since the operation of motors, magnetos, transformers and generators depends upon the magnetic properties of iron and steel, the magnetic testing of these materials is of the greatest importance to the electrical industry. The design and efficiency of such apparatus depends upon a thorough knowledge of the magnitude of those magnetic properties which can only be ascertained by careful tests. The scope of the work of the Bureau of Standards in magnetic testing is given, and the methods of measurement employed are described in considerable detail.

Steel and Its Heat-treatment. By Denison K. Bullens. 431 pages, 6 by 9 inches. 223 illustrations. Published by John Wiley & Sons, Inc., New York City. Price, $3.75 net.

The importance of proper heat-treatment of steel is now widely appreciated, due chiefly to the development of heat-treating practice by the automobile manufacturers. No mechanism is subjected to more severe service than a motor car running at high speed over poor roads. The necessity of building machines that are both light and dependable has revolutionized the practice of manufacturers of axles, gears and other vital car parts. This book, by a consulting metallurgist, was written in the light of recent experience with a keen appreciation of the nature of the problems and the needs of steel users. It treats of the testing of steel; the structure of steel; annealing; hardening; tempering and toughening; case carburizing; case-hardening and thermal treatment; heat generation; heat application; carbon steels; nickel steels; chrome steels; chrome-nickel steels; vanadium steels; manganese, silicon and other alloy steels; tool steel and tools; pyrometers and critical range determinations, etc. It is a work that we highly recommend to all in need of a modern treatise on heat-treatment and the characteristics of heat-treated steels. Modern apparatus is illustrated and described, and there is much valuable material, including formulas not elsewhere available.

NEW CATALOGUES AND CIRCULARS

Scranton Pump Co., Scranton, Pa. Bulletin 107 on Scranton triplex plunger pumps.

Fairbanks, Morse & Co., Chicago, Ill. Bulletin H 178 B descriptive of Type Y semi-Diesel oil engines of the horizontal pattern.

St. Louis Machine Tool Co., St. Louis, Mo. Catalogue 15 of St. Louis grinding, polishing and tapping machines and tapping chucks.

Hunter Saw & Machine Co., Pittsburg, Pa. Circular of Hunter duplex inserted-tooth saw blades, giving the results of endurance tests made on these saws.

Speed Controller Co., Inc., 257 William St., New York City. Circular descriptive of the "Speedco" arc controller, an automatic precision feed for projection arc lamps.

Hunter Saw & Machine Co., Pittsburg, Pa. Circular of inserted-tooth setting device for setting teeth in Hunter duplex inserted-tooth saw blades up to 76 inches in diameter.

Murchey Machine & Tool Co., 34 Porter St., Detroit, Mich. Circular of the Murchey adjustable hand sizing taps, made in all sizes from 1¼ inch to 12 inches diameter.

Beighlee Electric Co., Cleveland, Ohio. Catalogue of Beighlee pyrometers of the thermo-electric type. Agent for the Eastern states, Herman A. Holz, 50 Church St., New York City.

Skinner Chuck Co., New Britain, Conn. Circular giving dimensions and capacities of Skinner universal geared screw chucks and scroll chucks, made with reversible and non-reversible jaws.

Vanadium-Alloys Steel Co., Pittsburg, Pa., has issued two folders descriptive of its "Vasco Choice" and "Vasco Non-shrinkable" grades of tool steel. These folders will be sent free upon request.

Conway & Co., Cincinnati, Ohio. Catalogue 12 B treating of Conway patent friction clutches of the compression and expansion types. The CMT clutch is designed expressly for countershaft service.

National Machinery Co., Tiffin, Ohio. National Forging Talk No. 9 describes a new design for grip slide alignment on forging machines, as exemplified in the National heavy-pattern forging machine.

Fairbanks, Morse & Co., Chicago, Ill. Bulletin H192 C outlining the details of construction of Fairbanks-Morse Type Y oil engines, adapted for all general power purposes and made for belt or direct drive.

Link-Belt Co., Chicago, Ill. Bulletin 229 illustrating and describing the new Link-Belt traveling water-intake screen which prevents driftwood, vegetation and miscellaneous trash from entering condenser intake pipes.

Roller-Smith Co., 203 Broadway, New York City. Bulletin 100 descriptive of electrical instruments for signal system testing, including direct- and alternating-current portable volt-ammeters and direct-reading portable ohmmeters.

Metalwood Mfg. Co., Detroit, Mich. Circular of the Metalwood quick-operating ten-ton flanging press, operating with a frequency of ten full strokes per minute and developing the full rated capacity of ten tons per stroke.

J. N. Lapointe Co., New London, Conn. Circular of the No. 3B broaching machine which supersedes the No. 3 machine formerly built. All gears are encased and are self lubricating. High-speed return is provided for the broach.

General Electric Co., Schenectady, N. Y. Booklets Y 784 and Y 785 devoted to street lighting brackets and center span fixtures for "Mazda" lamps, and "Novalux" street lighting units for "Mazda" series lamps, respectively.

George Gorton Machine Co., Racine, Wis. Bulletin 748 describing the Gorton 8 C universal horizontal routing machine for routing vent and powder grooves in fuse rings. The production maintained with this machine is from 25 to 30 rings per hour.

Lodge & Shipley Machine Tool Co., Cincinnati, Ohio. Bulletin 140, comprising a manual for operating Lodge & Shipley lathes. It contains directions for erecting and oiling the lathes and adjusting them for accuracy, and describes the various parts in detail.

Volcano Torch & Mfg. Co., Erie, Pa. Supplement to catalogue 19 showing the improved "Volcano" kerosene blow torch with an adjustable burner which can be directed vertically or horizontally. This torch is made in two styles, each providing a flame from 12 to 14 inches long.

Curtis Pneumatic Machinery Co., 1568 Kienlen Ave., St. Louis, Mo. Catalogue 63 covering the Curtis line of pneumatic machinery, which includes air compressors, air hoists, trolleys, trolley systems, sandblasts, pneumatic and hydro-pneumatic elevators and jib and traveling cranes.

Link-Belt Co., Chicago, Ill. Pamphlet 238 descriptive of Types AE and ZB Link-Belt grab buckets. The AE grab was designed to meet the demand for a high-speed bucket of greater digging power than can be secured with ordinary grabs. The ZB bucket is intended for the general run of work.

Moore Oil Co., Cincinnati, Ohio. Pamphlet of Moore cutting compounds, cutting oils, drawing compounds, soluble oils and quenching oils, giving directions for mixing, proportions to use, and information concerning the classes of work and kinds of materials on which these compounds give the best results.

Link-Belt Co., Chicago, Ill. Booklet 267 entitled "Moving Material Indian File," treating of the problems of transporting material throughout factories. The booklet illustrates conveyors for handling packages, barrel conveyors with automatic loaders, and various other types of conveying apparatus.

American Roller Bearing Co., Pittsburg, Pa. Bulletin 1003 treating of the application of roller bearings to all designs of machinery and equipment. The pamphlet illustrates and describes in detail the design and construction of American roller bearings and shows examples of machines equipped with these bearings.

Detroit Electric Welder Co., Detroit, Mich. Circular of Detroit electric spot and butt welders of all capacities. These machines can be used for welding a range of material from the lightest gage stock up to the heaviest, with a range of spots from one a minute up to 200 a minute, depending on the requirements of the work.

National Tube Co., Pittsburg, Pa. Three-year calendar—1916, 1917, 1918—with poster "Over-shadowing Supremacy," illustrating the relative merits of the grand prize, medal of honor, gold medal, silver medal and bronze medal awarded at the Panama-Pacific International Exposition. The "National" products received the grand prize.

Ingersoll-Rand Co., 11 Broadway, New York City. Form 3029 descriptive of Ingersoll-Rogler Class ORC duplex Corliss steam-driven air compressors; form 3036 descriptive of Ingersoll-Rand turbo blowers of the single-stage double-flow low-pressure type; form 4120 treating of Leyner-Ingersoll water drills, illustrating these drills in use in mine work.

Wardwell Mfg. Co., 114 Hamilton Ave., Cleveland, Ohio. Catalogue illustrating and describing the Wardwell line of saw and knife sharpening machinery and tools for the care of woodworking saws, metal cutting saws, planer and jointer knives, etc. Many of the machines shown in this catalogue are now being placed on the market for the first time.

Nordberg Mfg. Co., Milwaukee, Wis. Bulletin 27 A descriptive of Nordberg high-compression two-cycle oil engines, which are built in three sizes as follows: single-cylinder 50 H.P., single-cylinder 100 H.P., and twin-cylinder 200 H.P., running at speeds of 300 and 270 and 270 revolutions, respectively. Copies of this bulletin will be sent free upon request.

Goodell-Pratt Co., Greenfield, Mass. Supplement to catalogue 12 showing thirty new tools, comprising adjustable wrenches, speed indicators, motorcycle sets, motor sets, ratchet rim wrenches, ratchet braces, high-speed hand drills, breast drills, chisel and punch sets, socket wrench sets, cotter-pin pullers, circular glass cutters, double-end wrenches, aluminum level, etc.

Babson Statistical Organization, Wellesley Hills, Mass. Circular advertising Babson's statistical reports for use in purchasing coal and coke, copper, zinc, tin, iron, steel and rubber. By means of these reports it is possible to predict with some degree of certainty the price of raw materials for a certain definite time, and thus to purchase these materials with the greatest economy.

Cleveland Punch & Shear Works Co., Cleveland, Ohio. Calendar giving working days in each week for the months of April to September, 1916. On the front of each sheet are illustrated one of the Cleveland line of punches and work which can be done on these machines. The back of the sheet comprises an order blank for ordering Cleveland standard and special punches and dies.

National Tube Co., Pittsburg, Pa. Bulletin 26 treating of the welding of National pipe. The characteristics of National pipe are peculiarly adapted to the autogenous welding process. The bulletin il-

lustrates the welding of pipe lines and repairs that have been made on National tubing by autogenous welding, and contains a comprehensive discussion of the process, including costs for butt welding and cutting pipe.

West Haven Mfg. Co., New Haven, Conn. Circulars of drive pin punches in sets with points ranging in diameter from 1/16 to 3/8 inch; sets of center punches of 3/16, 1/4 and 9/32 inch body diameter; sets comprising one pin punch, one drive punch, one prick punch and three sizes of center punches; sets of one-piece screwdrivers, six inches in length, with blades of 2 3/4 by 3/16 inch; and slide or rigid T-handle tap wrench.

George Automatic Roller Bearing Co., 4614 Spring Grove Ave., Cincinnati, Ohio. Catalogue descriptive of the George automatic roller bearing, a unique type of bearing composed of tapered rollers separated by means of balls, no cage being employed. The conical ends of the rollers, acting in conjunction with the balls, overcome any tendency of the rollers to skew out of their true rolling axis. The booklet is illustrated with blueprints which make the construction very clear.

H. W. Wilson Co., White Plains, N. Y. Copy of the Industrial Arts Index published in February, April, June, October and December. This is a cumulative index to engineering and trade journals. The annual index for 1915 is ready, and contains 509 double column nonpareil pages. The index is of general interest to all who keep in touch with engineering literature. It saves them the trouble of making individual card indexes of their own, a very tiresome and laborious task.

Canton Foundry & Machine Co., Canton, Ohio. Catalogue of portable floor cranes and hoists. The Canton portable crane and hoist is mounted on a four-wheel truck and has an overhanging arm which permits it to be run up next to a machine tool, a locomotive or other machine so that the load can be lifted or lowered into place. The hoist is made in a size suitable for use in garages and light machine shops, as well as in other sizes suitable for railroad shops, heavy machine shops, etc.

National Tube Co., Pittsburg, Pa. Bulletin 25 on National pipe in large buildings. This bulletin contains the pictures of many large buildings in New York, Chicago and other cities that have been equipped with National steel pipes. Data on the production of iron and steel pipes are included. Other valuable data for engineers are given, such as is found in handbooks. These include properties of pipe; of solid and tubular beams; safety factors and safe working fiber stresses; loss of head in pipe by friction; relative discharging capacities of pipe; flow of steam, etc.

W. S. Rockwell Co., 50 Church St., New York City. Bulletin 30, descriptive of Rockwell automatic furnaces for annealing, hardening, tempering, etc. The illustrations show special equipment for continuous heat-treatment of shells, billets and material of like nature, continuous end-heating furnaces, semi-automatic annealing and hardening furnaces, continuous die annealing and hardening furnaces, automatic hardening furnaces and automatic rotary annealing furnaces. This bulletin is not intended as a catalogue only of furnaces, but rather as a discussion of the problems attending the development of automatic heating.

Mortimer J. Silberberg, 122 S. Michigan Ave., Chicago, Ill. Circular of the master chronograph for time study. The watch is a guaranteed high-grade seventeen-jewel timepiece which gives direct readings and operations per hour, thus eliminating mental and written computations. The circular analyzes the three prime causes for lost time and motion: (1) Improper tools, machinery or lack of facility furnished the employe. (2) Lack of knowledge on the part of employe as to how the work in hand can be completed with the least number of motions and least amount of exertion or fatigue. (3) The employe's not being physically or mentally fitted for the particular class of work apportioned to him. The master chronograph may be used for eliminating lost time and motion and for placing employes most advantageously for themselves and their employers.

Brown & Sharpe Mfg. Co., Providence, R. I. Catalogue 136 of machinery and tools. This well-known catalogue has been issued regularly for years and is found in the tool chests or libraries of many machinists and toolmakers as well as manufacturers' files. The business of Brown & Sharpe was founded in 1833, and from a very small beginning it has grown until now the present buildings have 1,029,900 square feet of floor space, or about 23½ acres. Besides the regular lines of machinery and machinists' tools shown in previous catalogues, a number of new machines, attachments and tools are listed, among which are No. 00 hand milling machine, No. 3 heavy automatic gear cutting machine, No. 5 automatic gear cutting machine, No. 13 heavy automatic gear cutting machine, No. 1 spur gear testing machine, No. 0 spur gear testing machine, bevel gear testing machine, "Rex" micrometer caliper (a low-priced caliper made to meet manufacturing requirements), dial test indicator, sets of standard tools, etc.

General Electric Co., West Lynn, Mass. Booklet describing the apprentice system of the company which has been developed under the direction of M. W. Alexander. The apprentice system was developed in order to train young men for service in various branches of the company's activities or in power and lighting stations, transportation companies and other industrial establishments using electrical machinery and steam apparatus. The booklet is illustrated with views of the apprentice training room, machine shop, class room, pattern shop, patterns made by apprentices, apprentice training room foundry, class room in mechanical drawing, class room in mechanics, motor winding department class room, electrical test department class room, etc. The booklet will be of general interest to all young men desirous of securing the sort of training afforded by this apprenticeship course, and it should also be of interest to manufacturing concerns that have realized the need of training young men for their service and are developing plans to provide it.

S. K. F. Ball Bearing Co., Hartford, Conn. Catalogue entitled "Ball Bearings as an Automobile Sales Factor," which is intended to help automobile salesmen promote the sale of cars by giving attention to the relative advantages of ball bearings. However, the book will repay the attention of users of ball bearings in any type of machine. Two pages contain questions and answers on ball bearings, some of the questions being: What are bearings used for? What types of bearings are used in motor cars? Which are the most widely used? Why? What is a ball bearing made of? What are the distinct advantages of S. K. F. ball bearings? Some of the subjects discussed are the use of bearings in general, features that determine the best types of bearings, and the ball as a supportive element. A brief sketch of the origin, constituents and manufacture of S. K. F. steel is given, and the fundamental features of design of S. K. F. ball bearings are explained. The section entitled "Where and Why S. K. F. are Used" gives the following uses: on axles, rear hubs, full floating type axles, three-quarter floating axles, semi-floating axles, final drives, propeller shafts, jack-shafts, transmissions and front wheels. The engineers glossary included gives some engineering details of S. K. F. bearings, such as testing the hardened steel, construction of the S. K. F. retainer, application of ball bearings to worm drives, etc. Curves are given for determining the loads on worm and worm-wheel bearings. Mention of this book would not be complete without reference to the excellence of its typographical appearance. Each page has a decorated border showing attractive views of automobiles on the city street, in the mountains, on the race-track, tractors engaged on construction work, etc. The illustrations are many and of a particularly high grade.

TRADE NOTES

Wyman & Gordon Co., Worcester, Mass., manufacturer of drop-forgings, has changed its name to the Wyman-Gordon Co.

J. J. McCabe, 30 Church St., New York City, has moved his office to the Singer Bldg., 149 Broadway. The McCabe warehouses are in Jersey City, N. J.

Hydraulic Press Mfg. Co., 84 Lincoln Ave., Mount Gilead, Ohio, has opened a branch sales office at 416 Citizens Bldg., Cleveland, Ohio, in charge of Charles E. Newell.

S. K. F. Ball Bearing Co., 50 Church St., New York City, has transferred its main office to the factory at Hartford, Conn. The New York office will be continued at the above address.

Morton Mfg. Co., Muskegon Heights, Mich., manufacturer of draw-cut shapers and keyseating machinery, was awarded the grand prize for its exhibit at the Panama-Pacific International Exposition at San Francisco.

Sherritt & Stoer Co., Inc., 603 Finance Bldg., Philadelphia, Pa., has been appointed exclusive sales agent for the Beaudry "Champion" and "Peerless" power hammers in the Philadelphia district.

Peter Bros. Mfg. Co., Algonquin, Ill., is building a 45- by 120-foot, two-story brick and cement addition to its plant, costing $10,000. The new building will increase the company's capacity for the manufacture of the Woodstock safety tapping chucks and attachments.

Desmond-Stephan Mfg. Co., Urbana, Ohio, manufacturer of the "Diamo-Carbo," Sherman, Huntington, "Magazine," Sherman-Huntington and "Diamond" grinding wheel dressers, has acquired the business of the Rupert Co. of Indianapolis, Ind., manufacturer of Huntington dressers.

Maino Machine Tool Co., Jackson, Mich., is the name of a new concern that has purchased the shaper business of the Walcott & Wood Machine Tool Co. of Jackson. The Maino Machine Tool Co. will manufacture and market the Walcott & Wood shapers hereafter. Harry Maino is the president of the new concern.

E. S. Cullen Machinery Co., 340 Leader-News Bldg., Cleveland, Ohio, is a new machinery selling concern organized by E. S. Cullen, formerly connected with the Niles-Bement-Pond Co. The new company will specialize in the selling of machine tools, locomotive and railway shop equipment, locomotive cranes, etc.

Sheffield Machine & Tool Co., 35 S. St. Clair St., Dayton, Ohio, is building special machinery, fixtures, jigs, dies and tools for manufacturers. In developing its facilities, the company will need more machinery, and it requests the catalogues of concerns building machines and accessories suitable for the class of work it is now engaged in.

Lober Art Brass & Specialty Co., Toledo, Ohio, is doing a large amount of heavy gage steel spinning for automobile concerns. This work is mostly for experimental cars and gives the plant engineers a chance to try out steel parts before ordering the dies. In some cases where the amount is not large, the company has filled quantity orders and thus has saved tool cost and made prompt shipments.

Westinghouse Electric & Mfg. Co., E. Pittsburg, Pa., recently sold the electrical equipment for driving a new 40-inch reversing rolling mill to the National Tube Co. for installation in its plant at Lorain, Ohio. This rolling mill, when completed, will be one of the largest in the country. The reversing motor will develop 15,000 horsepower and will run at a maximum speed of about 120 revolutions per minute.

Albaugh-Dover Co., Chicago, Ill., manufacturer of cream separators and specialist in gear cutting, has made plans for a new machine shop 90 feet by 175 feet which will cost from $25,000 to $30,000. The plant is operated on the 24-hour schedule, and has been working day and night for more than three years. The addition was required to take care of the increased volume of business in cream separators and gear cutting.

Chicago Pneumatic Tool Co., 1060 Fisher Bldg., Chicago, Ill., recently shipped a 13,000-pound "Chicago Pneumatic" air compressor and four "Hummer" hammer drills, to the International Trading Co., New York City, who will reship these machines to South America, where they are to be used in the construction of sewerage systems and water works in the cities of Paysanda, Mercedes and Salto in the Republic of Uruguay.

American Tool Works Co., Cincinnati, Ohio, held its annual meeting of stockholders March 30, at which the estate of the late Franklin Alter was represented by Walter Hofer and Clifford Wright. The following officers were elected: J. B. Doan, president; Robert S. Alter, vice-president and foreign manager; Henry Luers, secretary and treasurer. The following directors were appointed: J. B. Doan, Robert S. Alter, L. E. Voorheis, Clifford Wright and Walter Hofer.

Quigley Furnace & Foundry Co., Springfield, Mass., has added to its business a brass rolling mill department for the production of flat brass. A new name, Metals Production Equipment Co., has been adopted as being more comprehensive of the products. No change will be made in the general policy or management. The furnace, foundry and powdered coal departments will be continued as heretofore. The sales office of the company is at 105 W. 40th St., New York City.

Crofoot Gear Works, 31 Ames St., Cambridge, Mass., have taken over the New England Gear Works of Boston, including the good will, and have moved the entire plant to their factory in Cambridge. The new factory has been occupied for nearly a year, and in addition to the machinery acquired from the New England Gear Works, the company has installed a large number of new machines which provide facilities for a wide range of work. The factory is five stories high and fireproof.

Bullard Machine Tool Co., Bridgeport, Conn., has let a contract to the Turner Construction Co. of New York City for a continuation on Railroad Ave. of the concrete building which extends from Allen St. to Railroad Ave. on Broad St. The present building is 278 feet long, five stories high, and 50 feet wide. The new building is of similar construction, 110 feet long, and will replace the four-story brick machine shop which now occupies the site. The addition will increase largely the manufacturing facilities.

Steel Products Engineering Co., Springfield, Ohio, is the Springfield branch of the Gem City Machine Co., which was incorporated for $100,000 March 1. The company has purchased a 3½-story building, formerly occupied by the American Concentrator Co., located at Dakota Ave. and Columbia St. The building affords something over 10,000 square feet of floor space and it has been equipped for making tools of all kinds and for doing contract manufacturing. The tool-room equipment of the old company has been more than doubled, and one department has been added for all kinds of contract manufacturing.

Walcott Lathe Co., Jackson, Mich., is the successor to Walcott & Wood Machine Tool Co. The Walcott & Wood Machine Tool Co. was the successor to George D. Walcott & Son. These companies have been manufacturing lathes in Jackson for the last thirty-five years. The shaper business has been sold to the Maino Machine Tool Co. of Jackson, which will continue the manufacture of shapers under the name of Walcott. The Walcott Lathe Co. has a shop affording about 60,000 square feet of floor space and is building lathes in 14-inch, 18-inch, 20-inch and 25-inch sizes. The shop is equipped with up-to-date machinery, most of which is motor-driven, and it has all the facilities required to produce lathes in quantities.

J. N. Lapointe Co., New London, Conn., gave a banquet to about 140 of its employes at the Crocker House in New London, Saturday evening, April 8. The banquet is given each year for the purpose of establishing and cementing friendly social relations, and in order that this object shall be fully appreciated and understood the company makes a substantial gift each year to each employe in the shape of a bonus divided among them in proportion to their earning capacities. This bonus is 3 per cent of the total sales of the company and amounts to an average of a 10 per cent bonus of each employe's wages. Thus, if a man makes $1200 a year, his bonus is about $120. The friendly spirit manifested at the banquet convinced a representative of MACHINERY who was present that the company's liberal policy works to the mutual advantage of both the company and employes. J. N. Lapointe and Frank Lapointe were presented with handsome traveling bags by the employes as a token of appreciation. The company has been very successful in establishing sympathetic relations, a condition altogether too rare in manufacturing concerns generally. A tract has just been purchased at Pequot and Maple Aves., with twelve tenements, adjoining the present plant which will afford room for doubling its capacity.